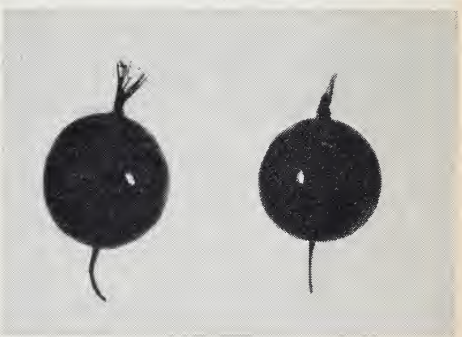
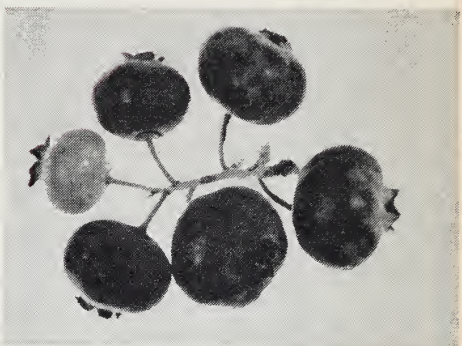


COMMERCIAL

bush berry

**GROWING IN
CALIFORNIA**

R. E. BAKER — H. M. BUTTERFIELD





A boysenberry planting, on two-wire trellis, in southern California.

Bush berries

are important commercial crops in certain counties near San Francisco and Monterey bays, in the San Joaquin Valley, and in the counties of southern California that are near large markets.

With a high yield per acre and a reasonable market price, berries can be a high income crop.

With a poor yield per acre or inadequate preparation for the vital harvesting period, growing bush berries can be financially disastrous.

Success depends on . . .

At least one uncontrollable factor—the price offered.

A number of controllable factors such as:

Arranging for a market before the harvest period.

Locating the planting near a ready market.

Making sure that adequate labor is available when it is needed.

Taking advantage of cultural practices that are known to improve yields.

This circular

attempts to point out the economic and agricultural factors involved in the successful growing of bush berries on a commercial scale, and gives directions for some of the cultural practices that make for increased yield per acre.

Where to find it

	Page
The economic factors involved	5
The agricultural factors	10
Descriptions of varieties	
Trailing blackberries	11
Erect blackberries	14
Raspberries	14
Currants	16
Gooseberries	17
Blueberries	18
Picking a location	20
Propagation and planting	22
Cultivation	25
Weed control by spraying	26
Irrigation	26
Pruning and trellising	28
Types of trellises	33
Fertilizer	34
Diseases and their control	35
Insect pests and their control	40
Harvesting—preparation	43
Harvesting equipment needed	45
Picking operations	48
Sales and shipping	49
Acreage table	50
Varietal charts	50–54
List of additional reading	55

COMMERCIAL BUSH BERRY CULTURE IN CALIFORNIA

R. E. Baker

H. M. Butterfield

Successful raising of bush berries on a commercial scale, in California, depends on both economic and agricultural factors, neither of which can be ignored. Anyone who is now growing bush berries, or is thinking about going into the business, will need to know the answers to a number of questions such as:

Who buys berries, and why?

Housewives are, of course, the ultimate buyers of practically all berries. They buy them fresh for serving with meals, for canning or preserving, or making pies. They buy berries already canned, or in jams and jellies, or frozen.

The grower very seldom sells berries direct to the consumer—he sells either to the fresh market, or to processors.

Consumers buy berries primarily for their fine flavor, and secondarily for their food value. Berries retain most of their original food value, even after processing.

What is the competition?

Both Oregon and Washington have climatic and soil conditions that appear excellent for berry raising. Both of these states have more acreage planted to bush berries than California, and yields in both states (with the exception of boysenberries) are equal to, or exceed those obtained in California. Thus competition from Oregon and Washington berry growers can become rather sharp.

What has happened in the past?

For many years, commercial berry

production in California declined in total acreage. Since the war, due to high prices obtained, and the increase in purchases by canners and freezers (table 1), berry acreage has increased. The increase in the tonnage sold to canners and freezers has resulted in a decrease in the tonnage sold to the fresh market, but the over-all tonnage of berries being grown and sold has increased.

Where the saturation point is, nobody knows. It may have been reached for boysenberries, unless new markets are found.

In past years, when nearly all of the berries were shipped to the fresh markets in San Francisco and Los Angeles, berry growers were obliged to locate their plantings near these markets. In the last few years, however, due to lower trucking prices, and the establishment of canning and freezing plants in many parts of the state, growers have had a much wider choice in location of plantings. This has, in turn, resulted in an increase in berry acreage in the warm, inland counties, where cultural conditions are favorable for some types of berry raising.

Costs and returns

Since no one can say for sure what will happen to prices offered for berries, or to labor and other costs involved in commercial production, figures for past years may not mean much when projected into the future. However, as a basis for comparison, the figures in tables 2 and 3 (on pages 6 and 7) are given. They show the weighted averages of costs and returns

The Authors:

Richard E. Baker is Assistant Professor of Pomology and Associate Pomologist in the Experiment Station, Davis.

H. M. Butterfield is Agriculturist in the Agricultural Extension Division.

TABLE 1—California Frozen Berry Pack

Kind of berry *	1949	1948	1947	1946
	pounds	pounds	pounds	pounds
Blackberries.....	375,736	†	6,315	190,551
Boysens.....	9,310,507	6,178,859	8,341,642	4,133,965
Logans.....	1,952,455	3,188,947	449,035	656,223
Youngs.....	490,614	568,321	760,233	1,522,020
Other bush berries.....	.....	493,639	169,561	152,792
Total.....	12,129,312	10,429,766	9,726,786	6,655,551
Strawberries for comparison.....	9,285,433	12,977,902	8,306,041	3,916,119

* The most common size of package for frozen blackberries, Boysens, Youngs, and strawberries is the 20-30 pound container. Most of the Logans are packed in 30-40 pound containers, with the 20-30 pound size second in importance.

† Included under other bush berries.

Source of data: Western Frozen Food Processors Association, San Francisco.

for a number of plantings in Stanislaus County during 1947, 1948, and 1949, where both the yield per acre and the price increased from one year to the next. (The 1947 figures only are given in table 2, and are indicative of figures for later years because costs have changed very little since that time.)

From what has happened in the past, and what can be surmised for the future, it is possible to arrive at the following conclusions regarding the commercial growing of bush berries:

1. Bush berries can be a high income crop. It is possible to obtain a gross income of \$4000 per acre, with a yield of 10 tons per acre and a price of 20c per pound.

2. It is also possible to sustain a heavy

loss, when conditions are unfavorable as to yield per acre, a readily available market, and price.

3. Some of the factors governing the commercial success of bush berries may be controlled to a certain extent; some may not.

4. While the unusually high prices paid for berries during the war years may not hold for the future, there is no reason why, with a high yield per acre and a reasonable price, bush berries cannot be a dependable source of income.

The following pages will examine both the economic and agricultural factors that govern the successful raising of bush berries on a commercial scale, and suggest ways in which the controllable factors may be made to contribute to success.

The economic factors . . . what about costs, yields, returns?

A prearranged market. As stated above, the two large markets for fresh berries in California are in San Francisco and Los Angeles. Some red raspberries are shipped fresh to out-of-state markets. Canning and freezing plants are scattered throughout the state. Prices paid by these

three types of markets will vary from year to year, and in different localities. (See table 4, page 9.)

Regardless of where the berries are sold, it is essential that a grower have a well established market for his crop, and

(continued on page 8)

**TABLE 2—Costs per Acre for Establishing Plantings of Boysenberries
Stanislaus County, 1947**

	Weighted average
Number of records.....	5
Number of acres.....	44.5
Labor costs per acre	
Planting.....	\$ 14.63
Fertilizing.....	6.56
Hoeing.....	20.57
Cultivation and weed spray.....	26.87
Irrigation.....	12.93
Building trellis.....	35.59
Miscellaneous.....	.70
Total labor cost.....	\$117.85
Material costs per acre	
Irrigation water.....	\$ 1.78
Fertilizer.....	20.07
Plants.....	78.76
Posts, stakes, and wire.....	85.92
Other materials.....	3.13
Total material cost.....	\$189.66
Cash overhead costs per acre	
General expense.....	\$ 15.38
County taxes.....	5.11
Insurance.....	.80
Total cash overhead.....	\$ 21.29
Depreciation costs per acre	
Irrigation facilities.....	\$ 6.10
Tillage equipment.....	.92
Spray equipment.....	.16
Miscellaneous equipment.....	.23
	\$ 7.41
Total costs except interest.....	\$336.21
Average investment per acre	
Irrigation facilities.....	\$ 41.74
Tillage equipment.....	4.39
Spraying equipment.....	1.18
Miscellaneous equipment.....	.57
Land.....	486.52
Total investment.....	\$534.40
Interest on average investment at 5 per cent.....	\$ 26.72
Total all costs per acre.....	\$362.93

TABLE 3—Costs, Returns, and Earnings on Bearing Boysenberries

	1947 weighted average	1948 weighted average	1949 weighted average
Age of planting	1	1.6	3
Number of acres	25.5	44.5	44.5
Yield, pounds per acre	6,573	8,419	10,484
Average price received per cwt.	\$ 8.25	\$ 11.54	\$ 7.96
Total cost of production per cwt.	7.00	6.90	7.08
	\$ 1.25	\$ 4.64	\$.88
Production costs per hundredweight			
Preharvest labor	\$ 1.85	\$ 2.09	\$ 2.25
Picking and hauling	3.01	3.16	3.07
Total labor cost	\$ 4.86	\$ 5.25	\$ 5.32
Total material cost	.40	.27	.53
Cash overhead cost	.38	.39	.42
Depreciation cost	.79	.56	.46
Interest on investment cost	.57	.43	.35
Total cost per cwt.	\$ 7.00	\$ 6.90	\$ 7.08
Labor costs per acre			
Prune, put up vines, pin back	\$ 72.06	\$ 101.35	\$ 187.57
Fertilizing	4.63	2.59	10.89
Spraying and dusting	2.82	2.69	3.18
Hoeing and weed control	17.80	45.65	8.43
Cultivation	10.31	12.17	16.19
Irrigation	14.20	11.41	9.30
Subtotal preharvest labor	\$ 121.82	\$ 175.86	\$ 235.56
Picking and hauling	198.02	266.31	322.48
Total labor cost per acre	\$ 319.84	\$ 442.17	\$ 558.04
Material costs per acre			
Irrigation water	\$ 1.71	\$ 1.78	\$ 3.45
Fertilizer	19.20	16.42	43.08
Spray material	2.23	1.24	2.80
Miscellaneous, including weed spray	3.47	3.22	6.17
Total material costs per acre	\$ 26.61	\$ 22.66	\$ 55.50
Total labor and material cost per acre	\$ 346.45	\$ 464.83	\$ 613.54

(Continued on page 8)

TABLE 3 (Continued)—Costs, Returns, and Earnings on Bearing Boysenberries

	1947 weighted average	1948 weighted average	1949 weighted average
Cash overhead costs per acre			
General expense (5% labor and material cost)	\$ 17.32	\$ 23.24	\$ 30.68
County taxes	5.10	5.20	5.49
Insurance	2.73	4.08	8.14
Total cash overhead cost	\$ 25.15	\$ 32.52	\$ 44.31
Depreciation costs per acre			
Vines	\$ 40.63	\$ 36.60	\$ 36.59
Irrigation facilities	4.55	6.29	6.29
Tillage equipment	.86	.92	1.57
Spraying equipment	3.94	2.27	2.27
Harvesting equipment	.83	.96	.95
Miscellaneous equipment	.69	.49	.49
Total depreciation cost	\$ 51.50	\$ 47.53	\$ 48.16
Average investment per acre			
Vines and trellis	\$ 203.14	\$ 183.01	\$ 183.02
Irrigation facilities	22.77	43.01	43.01
Tillage equipment	3.96	4.39	7.64
Spraying equipment	15.81	9.58	9.58
Harvesting equipment	1.49	1.70	1.71
Miscellaneous equipment	1.33	1.01	1.01
Land	500.00	486.52	486.52
Total average investment	\$ 748.50	\$ 729.22	\$ 732.49
Interest on average investment at 5 per cent.	\$ 37.43	\$ 36.46	\$ 36.62
Total all costs per acre	\$ 460.53	\$ 581.34	\$ 742.63
Total returns per acre	541.94	971.70	834.81
Management income per acre	\$ 81.41	\$ 390.36	\$ 92.18

Source of data: Based on Enterprise-Management Studies in Stanislaus County, Agricultural Extension Service, 1947, 1948, and 1949.

a definite commitment with the buyer *before the crop is ready for harvesting*. Due to the extreme perishability of the fruit, there is no time to scout around for a market or a better price after the berries are ready for picking.

Growers who belong to or sell through a coöperative, or other marketing agency

sometimes have this factor taken care of automatically.

Available labor. Next in importance to having a prearranged market is the necessity of having an adequate supply of labor available at the time the berries are ready for harvesting. During the early part of the season (for most berries) rela-

TABLE 4—Carlots* of Bush Berries for Los Angeles and San Francisco Markets

Berry and market	1949 carlots	1948 carlots	1947 carlots	1946 carlots
Blackberries				
Los Angeles.....	6	4	8	4
Oakland†.....	7	..	..	..
San Francisco.....	14	17	20	12
Total.....	27	21	28	16
Boysen, Nectar, and Young				
Los Angeles.....	125	94	143	68
Oakland.....	26	..	..	..
San Francisco.....	35	27	41	16
Total.....	186	121	184	84
Logans				
Los Angeles.....	1	..	..	..
Oakland.....	4	..	..	..
San Francisco.....	6	7	7	2
Total.....	11	7	7	2
Raspberries				
Los Angeles.....	21	20	15	14
Oakland.....	5	..	..	..
San Francisco.....	16	13	14	11
Total.....	42	33	29	25
Blueberries				
Los Angeles.....	2	1	..	..
Oakland.....	..	..	..	..
San Francisco.....	..	1	..	..
Total.....	2	2	..	..
Gooseberries				
Los Angeles.....	..	1	..	..
Oakland.....	..	..	..	..
San Francisco.....	..	..	..	..
Total.....	0	1	0	0

* Includes unloads by freight, boat, express, parcel post, and truck receipts, converted to carlot equivalents, 1,800 trays or crates to each carlot.

† Figures for earlier years not available.

Source of data: Federal-State Market News Service.

tively few pickers will be needed, but during the peak of the season, a full crew should be in operation or available when needed. Once the berries are ready for picking there can be no waiting.

With this in mind, many growers limit the size of their plantings to that which can be handled by members of the family and local labor. This is not necessary when there is an adequate supply of

migratory labor available, but is important in times of labor shortages, as was pointed out during the war years.

Cutting costs. A survey conducted by the Agricultural Extension Service in 1949 showed that about 79 per cent of the total returns from boysenberry plantings was paid out for labor. The actual cash outlay can be reduced, of course, if the grower and his family perform a substantial amount of the labor.

In some places the cost of irrigation water runs high. Applying more water than is necessary is wasteful, and tends to run up costs and detract from income.

Fertilizing may run from \$6 to over \$150 per acre. Costs can be cut by taking the trouble to determine what kind of fertilizer is needed, then purchasing the kind that is most suitable and applying it in adequate but not excessive amounts.

The point is that bush berries, being a relatively high income crop, with an opportunity for good profits for the grower, also require a high degree of skill in management practices. Without "cutting the corners" high costs can do away with any management profit that might accrue, in spite of a favorable price.

Yield-income relationship. The yield per acre has a direct bearing on the income derived from any crop. The relationship between yield per acre and income from bush berries is especially important.

The difference between a good yield and a mediocre yield per acre can make the difference between a profit and a loss for the grower, in any given season.

Certain costs per acre involved in

bringing the berries up to the producing point tend to remain about constant: water bills; labor expenses, etc., for pruning, placing canes on trellises, picking; picking supplies. So unless each acre produces sufficient berries to pay off these costs and leave enough over for the grower the entire operation is commercially useless.

The following table, compiled from figures obtained on berry farms in Oregon, in 1947, shows how rapidly the cost per pound goes down (hence income per acre goes up) as the yield per acre goes up for boysenberries:

TABLE 5.—Yield per Acre as a Factor in Cost

Yield (in tons per acre)	Cost (in cents per pound)
Less than 1 ton	26.2
1-2 tons	13.5
2-3 tons	11.0
3-4 tons	8.7
4 or more tons	7.4

Yield per acre can, to a certain extent, be controlled by good cultural methods, as described later in this circular.

Location. As can be seen above, location of a planting should be such that there is a well established market nearby, and an adequate supply of labor available at harvest time. Agricultural factors (as outlined later in this circular) may, however, have more bearing on the location of plantings than the economic factors mentioned above.

And these are the agricultural factors that must be watched

Some varieties of bush berries produce much better in California than others (see description of varieties starting on the opposite page).

In some cases, notably among currants

and gooseberries, there do not seem to be any varieties that are well adapted to California conditions.

Blueberries do fairly well in the state, but seem to prefer the acid soil condition

found in the Redwood belt along the Coast Range of mountains in central and northern California. This tends to limit the potentially productive planting areas for this group of berries.

By and large, all berries require fertile soil and maintenance of considerable soil moisture in order to produce well. This can be an important factor in the expense involved in getting the crop ready for harvest.

The remainder of this circular will be devoted to the agricultural factors involved in successful bushberry raising, including:

1. Choice of varieties that will give the best yield under local conditions.
2. Cultural practices that will tend to increase the yield.
3. Control of diseases and pests.

This is the most important group of bush berries in California because it represents the greatest acreage and includes the varieties from which the heaviest yields have been recorded. The varieties in this group are listed, together with some brief facts about them, in the order of their commercial importance in the state.

Boysen. The Boysen is grown generally throughout the state because of its unusually high yield. In the Central Valley, under intensive methods of culture, 4 to 5 tons per acre are considered poor yields; 7 to 8 tons are not uncommon and 10 tons are attained by some growers. In the central coast area the average yield is 5 tons per acre. In the Sebastopol and southern California areas, 3 tons per acre is average.

The Boysen variety is high in quality and is in great demand as both fresh and frozen fruit. The berries are reddish in color and most are about $1\frac{1}{4}$ inches long

4. A description of materials needed and methods used to harvest the crop efficiently.

Berries as an intercrop. Some farmers have planted berries in between fruit or nut trees while the trees were young. Occasionally the berry crop has been more profitable than the fruit crop and the growers have been tempted to let the berries remain.

Since berry plantings should usually last for about 10 years and tree crops should be productive for 20 years or more, the individual grower must decide which crop will pay best under local conditions.

Berries should not be allowed to interfere with tree crops, and either the trees of the berries should be removed when competition for the space sets in.

Trailing blackberries (the most important group)—varieties

and 1 inch in diameter. The taste is sweet and the aroma abundant.

The plant is moderately vigorous, with thorns that are larger than those of the Logan, but smaller than those of the Himalaya. The foliage is dark green.

The picking season in southern California runs from about May 20 to June 25; in the San Joaquin Valley, from about May 25 to June 25; in Sebastopol from June 2 to July 10; in the central coastal area, from June 20 to August 1.

The Nectar variety differs from the Boysen in that the fruit of the Nectar is



Fruit of the Nectar variety of blackberry.

less acid, and slightly sweeter, and the individual drupelets are usually greater in diameter.

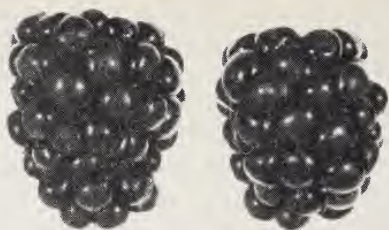
The plants can not be distinguished from those of the Boysen. The production areas and characteristics of the two varieties are similar or identical.

The Young variety is grown generally throughout the state because it ripens as much as 10 days earlier than the Boysen, and thus spreads the picking season of mixed plantings. It is being supplanted in popularity, however, because it will only produce from 50 to 70 per cent as much fruit in the same locality as Boysen and the fruit is not of as high quality.

The plants of the Young variety are less vigorous, and the leaves are lighter green. The berries have no distinct aroma and are shiny, in contrast to the dusty bloom that covers the Boysen.

Thornless Logan. This berry is most popular as a processing fruit because of its sour taste. It is best adapted to the central coast area of California, the only

The Logan blackberry—popular for pies, jams, jellies and juice—is losing favor with growers.



Fruit of the Young variety of blackberry.

place in the state where it is important commercially.

Under dry-farming conditions, the Thornless Logan will produce from 1 to 3 tons per acre. Irrigation will raise this yield to as much as 6 tons.

Given the proper cultural conditions, the Thornless Logan plant is vigorous. The fruit is about the same length as that of the Boysen, but smaller in diameter. The color of the fruit is light reddish and does not darken like that of the Boysen. The berries are covered with numerous fine hairs, giving them a dull, rather than shiny look. Thorns, when present at all, are very small.

Both the Thornless Logan and the Logan (see below) are susceptible to virus diseases which tend to shorten the life of productive plantings.

Logan. There is very little difference between the Logan and the Thornless Logan, except as suggested by the name. The former bears numerous fine thorns on the canes. The thorny Logan is also considered, by many growers, to be more susceptible to the dwarf disease.

For this reason, the Logan has become less popular among growers than the thornless variety.

Thornless Boysen. The Thornless Boysen has been planted generally throughout the state, but has not received much popularity because it is less vigorous and produces much lower yields than the thorny Boysen variety. The bushes are short-lived—usually about 2 or 3 years.

The fruit is medium in size, reddish black in color, and has about the same uses as that of the Boysen, but the quality



The Thornless Boysen, less vigorous than Boysen.

of fresh fruit is not as high. The picking season is about the same as that of the Young variety.

Himalaya. The Himalaya variety is not too popular with many growers because of its vigorous canes covered with long, hooked thorns which make pruning and picking operations extremely difficult.

This variety has, however, many good qualities to recommend it as a commercial crop in the central and north coast regions of the state. The quality of the fruit is good to excellent and can be sold fresh, for canning, or for freezing. The picking season begins late (about the first week in July) and extends through the middle of September.

Himalaya plants are extremely vigorous and long-lived. One planting in Santa Cruz County is known to be over 30 years old and is still productive. Canes on the Himalaya plants sometimes attain a diameter of $1\frac{1}{2}$ inches. Their maximum yield is 10 tons per acre.

The color of the ripe berries is jet black and shiny. They are small to medium in size and nearly round in shape.

Himalayas produce as heavily as Boysen in the central and north coastal regions, but their production possibilities in the central valley are not yet known.

Cory Thornless. The Cory Thornless (Thornless Mammoth) is a thornless mutation from the Mammoth blackberry that can be grown anywhere that the Young variety is adapted. The yield is about the same as that for the Young variety.

The fruit is smaller in diameter than the Boysen, but often 2 inches long. When mature, the fruit is black and shiny.

The picking season begins 3 or 4 days earlier than that of the Boysen and continues over approximately the same period. The quality is good and the fruit may be sold fresh, or for canning or freezing, but because of the small acreage planted in the state, the entire crop is currently being sold on the fresh market.

The plants are vigorous and nearly thornless, but this variety is susceptible to attack by the berry mite.

Thornless Oregon Evergreen. This variety is still experimental in California, and its adaptation to conditions in the state is not known. Indications are that it will produce fair yields in localities where the winters are unusually cold, but does not do as well after mild winters.

Present experimental plantings indicate that it would yield somewhat less than the Himalaya and considerably less than the Boysen. The picking season begins during the latter part of July and continues through August.

The fruit is small to medium in size, roundish in shape and black in color. It is suitable for canning and for shipment to distant fresh markets.

The plant is moderately vigorous and thornless. The leaves are deeply serrated, giving rise to the variety's other name—Cut-Leaf blackberry.

Phenomenal. Because this variety is unimportant commercially and extremely variable in type, it is mentioned here simply to indicate the true nature of the Phenomenal variety. Several different types of trailing blackberry have been sold under this name.

The true Phenomenal variety was introduced by Luther Burbank in 1897. The fruit is quite similar to that of the Logan, but the berries are slightly larger and softer in texture than the Logan. The drupelets are larger and more irregular and the fruit is less acid than the Logan.

Erect blackberries—just two varieties are grown commercially

Erect blackberries have never become very popular commercially because their yields are less than those of Boysen and Nectar. They are, however, desired by processors. The only varieties grown at all commercially in California are:

Lawton. The Lawton plant is vigorous and the canes are covered with long thorns, similar to those on the Himalaya variety. The fruit is medium in size, black, sweet, and of excellent quality. Good yield is 5 tons per acre.

The picking season (near Sebastopol—the only commercial planting in the state) begins about July 5 and continues

through to September 5. This usually conflicts with other harvesting seasons when pickers can make more money working on other crops.

Mountain Blackberry. There are a few commercial plantings of this variety in San Diego County where the picking season is the latter part of March or early April, and continues for 3 to 4 weeks.

The quality of the fruit is only fair and yields are only 1 to 3 tons per acre, but the extreme earliness of the picking season makes them commercially practical in that area. The entire crop is sold on the fresh market.

Raspberries—most varieties don't do well in California

None of the present known varieties of raspberries does well in California. Growers in Washington, for instance, get over 50 per cent better yields from raspberries than do the present growers in California.

For this reason, raspberry acreage in California is insignificant compared with that of trailing blackberries and there are no large commercial plantings of standard varieties anywhere in the state.

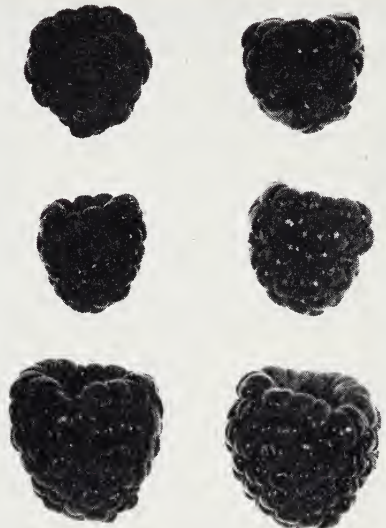
Apparently the future development of the raspberry industry in California must wait for the introduction of more suitable varieties. They are presently grown only in the central coast area.

The following is a description of the varieties that are grown commercially, together with information as to plant habits, etc., based on commercial and experimental plantings in the state:

Cuthbert. This variety used to produce a good spring crop and a moderately heavy fall crop, but recently the plants in California appear to have been subject to attack by a virus which reduces the vigor and yield of the plants below that necessary for success commercially.

Whether or not the trouble is due to a virus, the fact remains that Cuthbert plants are no longer popular with commercial growers because of poor yields.

The quality of the fruit is good, and is satisfactory for sale on the fresh mar-



Top to bottom: Cuthbert, Washington and Willamette varieties of raspberry. None is well adapted to growing in California.



Fruit of the Lloyd George variety of raspberry.

ket or for processing. Production begins during the latter part of May for the spring crop and the fall crop reaches a peak toward the latter part of September or early October. The fruit is medium to dark red, conical, firm, separates readily from the core, and ships well.

Lloyd George. Except for the peak of the spring crop, this variety has a rather poor yield. Production begins about May 20, in most years, and continues throughout October.

The fruit is uniform, and conical in shape. The quality is only fair.

Ranere. This variety is also known as Ranaree, and St. Regis. It is grown mainly in the Santa Clara Valley and one small planting has been observed in the Sierra foothills which, after 27 years, is still vigorous and productive.

The chief virtue of the Ranere variety is its heavy fall crop that is shipped to the eastern market. The berries are medium in size, bright red, and firm and are suitable for local fresh markets and for shipping to other fresh markets. They do not have sufficient quality to be in demand for processing.

The production season begins during the third week in May and continues



Ranere—gives a fair fall crop in some places.

through October. Excellent yield is 5 tons per acre.

Washington. As the name implies, this variety was developed for the state of Washington. It is not very well adapted to conditions in California. It produces a fairly heavy spring crop, beginning about the third week of May, but production drops off rapidly shortly after that.

The fruit is small to medium in size, bright red, conical, and of excellent quality.

The plants are vigorous and appear to be long-lived. The faults of this variety seem to be the small size of the fruit and the lack of production during the fall season.

Willamette. Information on this variety is not complete. The plantings studied in the central coast area did not appear to be very well adapted to California conditions, but since Willamette was developed for growing in the state of Oregon, it is possible that plantings in the northern end of California might produce well. This variety appears to require cold winters.

The fruit is medium to large, medium red, and uniform. While the quality is only fair, the large size of the berries helps to sell them on the fresh market, for they are attractive to the eye.

In the plantings studied, however, the production of this variety was very erratic and, in most seasons, entirely too light.

Cumberland. This is a black raspberry. In general, the production of black raspberries has been almost discontinued in California because of poor yields (about 25 per cent less than red raspberries).

The fruit is large, roundish-conical, firm, and of good quality, but unable to compete with red raspberries because of the poor yield.

For varietal charts of all bush berries, see pages 51 to 54.

Currants—California people are not familiar with them

Currants do not sell readily in California on the fresh market. Perhaps consumers have not been educated to the use of fresh currants. For this reason practically all of the currant crop in the state is sold to processors.

The lack of a variety that is well adapted to California conditions is another reason why development of commercial plantings has been delayed in the state. While currants are long-lived plants, they produce well only when irrigated. As an example, 3 tons per acre would be considered an excellent yield without irrigation; 6 tons per acre can be attained with irrigation.

Most of the currants grown commercially in California are raised in Alameda County, or near Bishop.*

* Because of the danger of currant plants acting as alternate hosts for white pine blister rust, plantings in the foothill areas of the Sierra are not advisable.

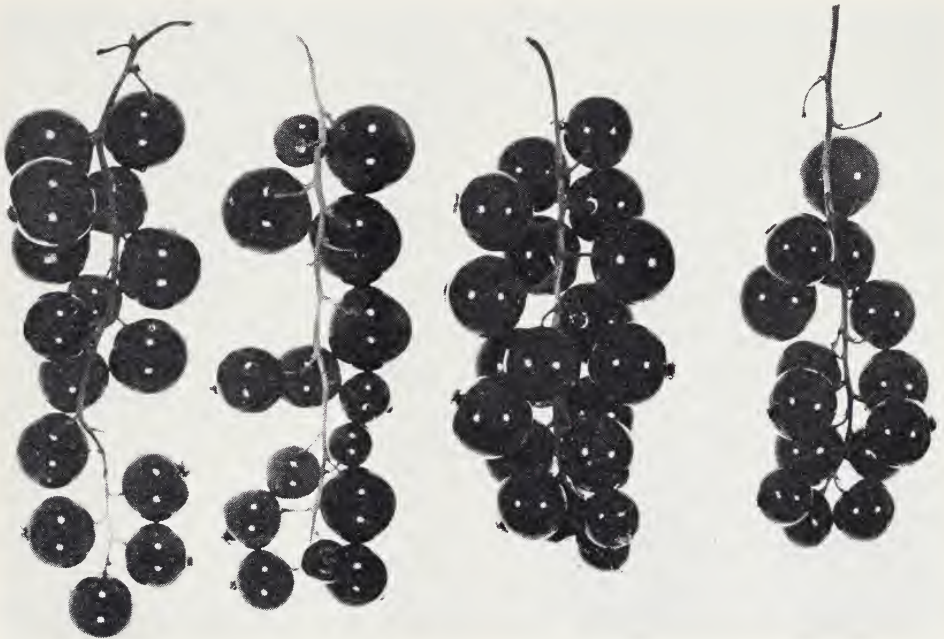
In the vicinity of Bishop the picking season begins the first week of July and continues to the end of the month. In the central coast area the season begins 2 to 3 weeks earlier and continues to about July 10.

The following is a list of varieties being grown in California—some commercially, and some in experimental plantings only:

Fays Prolific. This variety produces large, bright red berries of good quality in short, loose clusters. The berries have a tendency to ripen unevenly.

The plants are moderately vigorous, upright to spreading, and the foliage is moderately dense, giving a fair cover to the fruit.

In cool areas the fruit will hang on the vine for several days, or even for 2 weeks or longer. The grower is therefore able to wait until the entire crop has matured



Four varieties of currants grown in California. Left to right: Red Lake, Cascade, Fays Prolific, Perfection. Fresh currants do not sell readily in California; so nearly all are sold to the processing trade.

and then harvest all berries at one picking. This is often done because nearly all red currants are used for processing purposes at the present time.

If it should be desired to sell some of the Fays Prolific variety on the fresh market, the fruit can be picked over a longer period of time, beginning as soon as a sufficient number of clusters are ripe, continuing as long as the market price is good, or as long as the fruit will hang on the plants without shriveling.

Cherry. This has been the leading variety grown commercially in the central coast area.

The bush is fairly vigorous, medium in size and fairly productive, but is somewhat subject to attacks of mildew and cane borers.

The fruit is large, bright red; the clusters are of medium length and well filled.

The production season begins June 1 to 15, and continues to July 10.

Red Lake. Observations of experimental plantings made in the central coast and central valley areas indicate that this is the most productive variety available. It is thought that Red Lake will produce as much as 25 per cent greater yield than Fays Prolific.

The plant is moderately vigorous, spreading to upright, with dense foliage.

The individual fruits are mostly medium in size, with a few large berries in each cluster. They are medium red in color. Clusters are long, loose, and usually well filled. The quality is good.

Perfection. This variety has been observed in experimental plantings only.

The production is equivalent to that of Fays Prolific.

The plants are moderately vigorous, upright to spreading, with fairly dense foliage.

The individual berries are larger than any of the other varieties described, medium red in color and of good flavor. Clusters are moderately long and loose.

Cascade. Test plantings of this variety in California indicate that it ranks only slightly below the Perfection variety in yield. The production season is the same as that of Fays Prolific.

The plant is moderately vigorous, upright to spreading, with dense foliage.

The fruit is medium to large, bright red, fair to good in flavor, but when slightly overripe tends toward a rapid decline in acid content. The clusters are medium in length and fairly tight when the fruit is large.

Black form of Golden Currant. A black variety of the Golden currant has been grown successfully in Alameda County. Although plantings of this variety are very limited in extent, the bushes seem to give a fair yield and be less susceptible to trouble with mildew, and with borers, than the red varieties. The raspberry horntail may be troublesome at times.

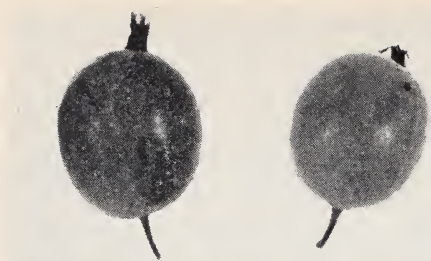
This black currant is not the true black currant referred to in restrictions for blister rust control (see page 16).

Gooseberries—just one variety is planted commercially

Oregon Champion is the only variety recommended for commercial plantings, since it seems to produce greater yields than any of the other varieties studied, either in commercial or experimental plantings in the state.

The fruit is light green to yellow in

Gooseberries are of only minor commercial importance in California, probably for the same reasons as those given for currants: there are no varieties too well suited for California conditions and consumers have not been educated to their uses.



Fruit of Oregon Champion variety of
gooseberry

color, medium to large in size, and of good quality. The plants are fairly vigor-

ous to vigorous, and the foliage is moderately dense.

This variety shows severe injury to even moderate salinity—the leaves show marginal scorch and the entire plant becomes dwarfed.

On the east side of the Sierra, the production season begins about June 1 and continues for several weeks. In the central coastal area, production begins approximately a week earlier. Excellent yield is 7½ to 10 tons per acre.

Blueberries—some varieties have not been thoroughly tested

Blueberries are adapted only to acid soils and relatively cool climates; so the central and north coast regions and possibly the Sierra foothills may be the only sections of the state where this crop can be grown. At this writing, commercial production in the state is limited to a few plantings in the vicinity of Santa Cruz, Sebastopol and Eureka.

Yields up to 1,000 crates (5 tons) per acre have been reported, but this yield could probably be doubled if irrigation water were available.

Nine commercial varieties have been observed, and these are discussed in their approximate order of ripening.

Rancocas is tall, vigorous, and the upright plants tend to overbear, so need severe pruning. They are propagated easily from hardwood cuttings.

The fruit is large, light blue, firm and of good quality. It ships well, but does not keep as well as some other varieties. The clusters are very tight; the scar (left when the stem is pulled) is medium in size.

In the Sebastopol area, the picking season begins June 10 to 15, and continues for approximately 4 weeks.

Scammel is erect, vigorous and the bushes appear to be productive in experimental plantings. The fruit is large,

dark blue, firm, with a slight aroma, and is above medium in dessert quality. The scar is medium size. The leaves are small and the fruit clusters are long and tight.

Dixi has vigorous, open, spreading bushes. Three-year-old plants in an experimental planting appeared to be very productive.

The berries are very large, hence desirable in the eyes of buyers. They are medium blue, firm, aromatic and of good quality. The scars are large.

Dixi variety is especially valuable for its large size and productivity.

Rubel variety has tall, vigorous, upright plants that are productive in commercial plantings. This is the easiest of the standard varieties to propagate from hardwood cuttings—it is fairly easy to propagate from soft wood, and is easily pruned.

The fruit is only medium in size, light blue, very firm and slightly aromatic. It is fairly good in quality and ships well. Its chief drawback is its small size.

The leaf is medium in size. The fruit cluster is very loose and the scar is good.

Atlantic variety is very promising because of the large size of the fruit, its productiveness and its good scar—one of the best.

The bush is very vigorous, open,

spreading with large leaves. The cluster is loose and the berries are large, firm, with slight aroma and above medium in quality.

Pemberton bushes are the most vigorous of all—erect, and apparently productive. This variety also propagates easily.

The fruit is large, dark blue, firm, with slight aroma, and medium to above in dessert quality. It has a poor scar.

The leaf is large—the fruit cluster is loose and very large.

Jersey plants are very vigorous and upright and do not sprout freely from the base. Production is good in commercial plantings, but this variety is somewhat objectionable because many of the stems tend to adhere to the fruit during picking operations. This makes it necessary to remove many of the individual stems from the fruit before placing them in the basket, thus running up the cost of picking operations.

The fruit is large, attractive, firm and keeps well. It remains acid and of good quality until it is fully mature.

The stems are long and the clusters open. The scar is good.

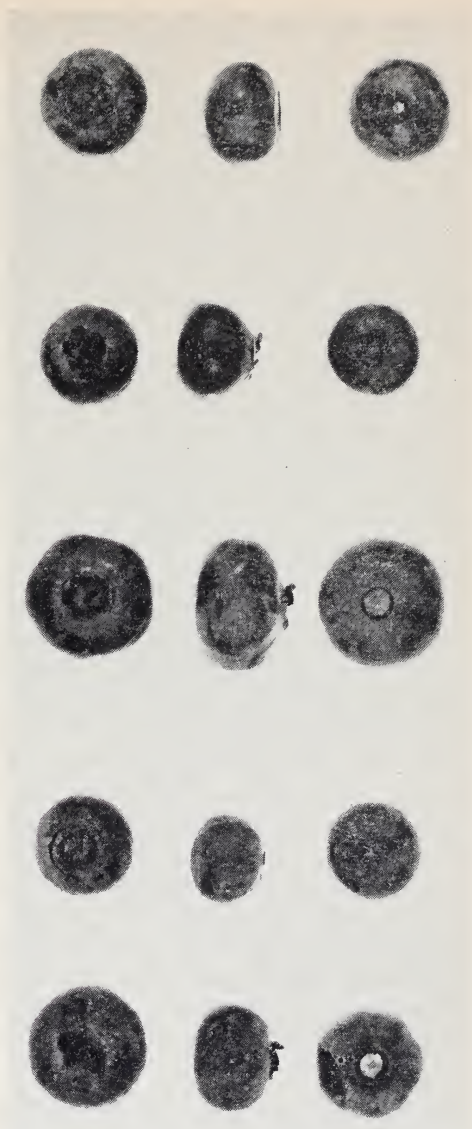
Burlington variety has bushes that are vigorous, upright and spreading. In experimental plantings that are only 3 years old, they appeared to be promising from a standpoint of production.

The fruit is medium size, good blue color, firm, with slight aroma, and above medium in quality. The scar is one of the best.

The cluster is medium tight. This variety can be propagated easily.



The following varieties have been observed in experimental plantings only and the bushes were too young to offer conclusive information, but all varieties showed promise enough to be worthy of trial in commercial plantings, because they ripen so early in the season. The addition of one or more of these varieties in plantings would give California



These are all blueberry varieties. Top to bottom: Atlantic, Burlington, Dixi, Pemberton, Scammel. All are grown commercially in California.

growers even more advantage on the early market than they now have over growers in the northwest.

Weymouth is the earliest of all varieties, ripening all berries quickly. The fruit, however, is poor in quality, above medium in size, dark blue, firm, lacking in aroma. The scar is medium.

The bush is erect, open, spreading, and of average vigor. The fruit cluster is medium loose; leaf above average size.

This variety is desirable only because of its earliness.

June. The bush is below average in vigor, erect with medium sized leaves. The fruit cluster is loose.

The fruit is medium in size, dark blue, with slight aroma; medium quality.

This variety is difficult to propagate.

Cabot is the standard for earliness in the state of New York, where it has been planted extensively.

The bush is below average in vigor, low, spreading. The fruit cluster is long and tight.

The fruit is small to medium, good blue color, not very firm, with slight aroma and poor texture. This variety is below medium in quality, and has only a fair scar.

Choosing a location—the soil, water, and climate are important

Trailing blackberries. Logans and Thornless Logans seem to do somewhat better in the cool coastal areas of the central and northern portions of California. The other common varieties of trailing blackberries appear to be widely adapted throughout the state. High yields have been obtained in such widely diverse locations as Tulare and Santa Cruz counties; so apparently location within certain parts of the state is not an important factor.

The exact soil requirements for optimum production in the different areas of the state are not known in detail. However, observations made regarding the most successful and productive plantings indicate the following general soil requirements:

1. The soil should be at least 4 to 6 feet deep.

2. It should be of the type that takes water readily, but dries out rapidly at the surface, so that picking operations can be carried on within 1 to 3 days after irrigation has been completed.

3. The soil should not be underlain with a hardpan or parent material at 4 to 6 feet. Such a condition is likely to bring about an accumulation of free water or an artificial high water table which may rise high enough to kill the roots of the berry plants. Such a condition can be

partially remedied by installation of a drainage system, or by special irrigation practices (see page 39).

4. The pH (relative acidity or alkalinity) of the soil should not be over 8.0, and preferably should be between 5.5 and 6.0.

5. Even moderate salinity (concentration of neutral salts) should be avoided. Blackberries are very susceptible to salinity.

6. Soils that are infested with verticillium wilt should be avoided. The Boysen, Young, and Nectar varieties are susceptible to this disease; the Logan and Himalaya varieties are relatively resistant.

Erect blackberries. Soil and moisture requirements for erect blackberries are essentially the same as those for trailing varieties, except that rapid water penetration does not seem to be so essential.

Erect blackberries appear to be generally adapted throughout the state.

Red raspberries. While raspberries can be and are grown successfully in several parts of the state, the central and north coast regions appear to be the most satisfactory for commercial production.

In general, soil requirements are as follows:

1. Soil should be at least 3 to 4 feet deep and of a type that permits rapid



Thornless Boysen planting that has been injured by an excess of salinity in the soil.

penetration of irrigation water. This is necessary because the available soil moisture for raspberries must be maintained very close to the surface for best production.

2. The soil must dry out rapidly after irrigation so that picking operations will not be hindered.

3. Avoid soil infested with verticillium wilt. The only variety grown commercially in California that is considered relatively resistant to this disease is Cuthbert.

4. Avoid salinity. While red raspberries are as resistant to salinity as trailing blackberries, excess salinity causes severe damage to any of the varieties that are grown commercially.

Currants and gooseberries. From the standpoint of climate, the central and north coast sections of the state are best for currants and gooseberries. While it is possible that they may be grown in the foothill areas of the Sierra, it is prob-

ably not advisable to do so because of the danger of their acting as alternate host for white pine blister rust.

Successful plantings observed in Alameda County indicate that currants and gooseberries will do well in medium to heavy textured soils that are neutral to slightly alkaline in reaction.

They apparently do not require soils which permit rapid water penetration, however they will not withstand submergence, even for a short period.

Saline soils should also be avoided. Severe injury can result from salinity.

Blueberries. There are many suitable locations for blueberries throughout the central and north coast regions of the state. These soils are mineral in nature and are not particularly high in organic matter, but apparently the organic matter which is present, plus additional amounts applied in the form of animal manures is sufficient for producing blueberries. Productive plantings have been

observed in such soils in the Santa Cruz and Sebastopol areas.

General soil requirements are as follows:

1. Good drainage. Surplus water during the growing season is always harmful.

2. An acid reaction. If the pH of the soil is above 5.8, the plants may be mottled-chlorotic (spotted with yellow in the leaves), indicating a need for more iron. Iron in the soil is readily available to the plants only when the soil reaction is below pH 5.8.

Propagation and planting—for either new or replacement stock

Most berry plants propagate easily. This factor is important for growers who wish to produce their own plants.

For new plantings, bushes may be purchased from a reliable nursery.

For replanting, or for increasing the size of existing plantings, it is sometimes less expensive (except for the labor involved) to grow plants from cuttings, layerings, or root cuttings of old plants. Plants secured in this way should be examined to make sure that they are not taken from diseased stock, or from stock infested with insects.

Trailing blackberries. The propagating method described for trailing blackberries also applies to black and purple raspberries, i.e., tip layering.

Cover the end of a cane 4 inches deep in a hole made with a trowel during the latter part of the summer. The covered part of the cane sends down roots from new stem growth and forms a plant that can be set out the following spring. One acre should furnish a minimum of 10,000 rooted tips.

Logan and Young tips are easily injured. For this reason, some growers prefer to use tips of these varieties that have been grown in the nursery row before being set out permanently.

Red raspberries and upright blackberries. These may be propagated either by suckers, or by root cuttings.

Suckers which arise from the roots may be dug up and used as new plants. In so doing, be sure to get a large enough section of the roots of the mother plant with

the sucker. This method is most common among commercial growers.

Most nurseries propagate plants by root cuttings. Dig up a number of old plants and cut the roots into pieces about 3 to 4 inches long. Set out these root cuttings in carefully prepared nursery soil. If given careful cultivation, and not allowed to dry out, they will produce plants large enough to set out in one year from the time the cuttings are made.

Currants and gooseberries. New currant and gooseberry plants may be obtained by cuttings.

Cuttings should be made during the dormant season. They should be from 7 to 10 inches long, of well-ripened one-year-old wood. They may be set out immediately in rows, or stored in moist sand in a cellar or other cool place until spring. When planted, they should be put in nursery rows, with one or two buds above the surface of the soil. Press the soil firmly around the buried portions. The resulting plants should be grown in the nursery for 1 or 2 years before being put out into the field.

Those varieties that do not root readily (see descriptions of varieties) may be propagated by mound layering. Heap the soil up around the lower part of the older plant high enough to bury several basal buds on each branch. These buds will then form lateral branches with roots at the basal portion. When roots are established (at least 4 months), cut off the branch below the new roots and handle as rooted cuttings.

Blueberries. Good results have been reported in rooting softwood cuttings of blueberries; hardwood cuttings root with difficulty.

Many growers will prefer to buy stocks for test plantings. Blueberry propagating stocks are available as follows:

Unrooted cuttings—ranging in length from 12 to 24 inches exclusive of buds.

No. 1 rooted cuttings—should have tops with 2 to 9 inches of new growth; only fairly well rooted.

2-year-old rooted cuttings—from 6 to 12 inches, with a minimum of 12 inches of total new growth.

3-year-old rooted cuttings—should be from 12 to 18 inches long, with a minimum of 24 inches of new growth.

4-year-old rooted cuttings—should range from 18 to 24 inches long.

As a rule, the older the cuttings, the

higher the price. Prices are usually quoted on lots of 10 to 100; 100 to 299; 300 to 999 and 1000 or more. Rooted cuttings of the smaller sizes sometimes include several popular varieties, such as Burlington, Cabot, Concord, Jersey, June, Pioneer, Rancocas, Rubel, Stanley, Atlantic, Dixi, Pemberton, and Weymouth. As a rule, rooted cuttings of Atlantic, Dixi, Pemberton, and Weymouth have brought premium prices. Stanley has also brought some premium prices.

To prepare the soil for planting, make sure that it is level, so that there will be little or no difference in elevation from one end of the irrigation furrow or check to the other. This step is not necessary, of course, for sprinkler irrigation.

If considered desirable, manure may be applied at a safe interval before planting. Some growers use 5 to 10 tons of un-

TABLE 6—Planting Specifications for Bush Berries

Berry	When to plant	Distance between rows	Space between bushes in row	Remarks
Blackberries	Feb. or March	8 ft.	8–16 ft.	Many growers space trailing blackberries 4 to 6 ft. in the rows, allowing twice as many plants to the acre
	Feb. or March	6–8 ft.	4–6 ft.	Planted in rows
		6–8 ft.	6–8 ft.	Planted in hills
Raspberries	Feb. or March	6–8 ft.	1½–6 ft.	Planted in rows
		6 ft.	6 ft.	Planted in hills
	Feb. or March	6 ft.	4–6 ft.	More spreading in nature
Currants and Gooseberries	Jan or Feb.	5–6 ft.	2½–5 ft.	Planted in rows
		5–6 ft.	5–6 ft.	Planted in hills
Blueberries	Jan. or Feb.	8 ft.	4 ft.	Planted in rows
		8 ft.	4 ft.	Planted in hills for cross cultivation



rotted cow manure per acre, 3 months prior to planting.

Before planting the soil should be wet to a depth of 10 to 12 inches. When it has dried out enough so that it will crumble readily, work it to a depth of 8 inches. It may not be necessary to work very sandy soils to this depth.

For pruning at planting time see page 28.

Bush berries should be planted so that they may be cultivated easily in one or two directions. They may be planted in hills, or in rows.

The planting distance is governed by the ultimate size of the plants, and by the size of the tillage equipment that will be used between the rows. For recommended planting times and distances see table 6.

Before planting blackberries, cut off the tips of the longest roots so the mass forms a compact clump several inches long.

Open a hole with a spade, large enough to admit the roots when they are spread out in a fan shape. Insert the plant to approximately the same depth at which it was grown in the nursery, i.e., so the crown bud is at the soil level. Firm the soil around the roots so that all portions of the root system come into immediate contact with the soil. To serve as markers for cultivation, the old stem of the plant is usually left sticking out of the soil. This may be cut off when the new shoots put in an appearance.

In large plantings it is sometimes easier to open long furrows, rather than to dig individual holes for each plant. In this case, place the plants along the landside of the furrow and handle in the same way as described for holes dug with a spade.

The two steps in actual planting of a blackberry bush. The plant should be put into the soil to approximately the same depth at which it grew in the nursery. Firm the soil around the plant by stepping on it.

Cultivation is kept to a minimum in most berry plots

Bush fruits are shallow-rooted. The roots also tend to spread out for some distance from the plant. This is an important factor in both cultivation and irrigation, as explained later in this circular.

Because of the shallow roots, the soil in berry patches should not be worked any deeper than 3 or 4 inches, and it should be worked even shallower close to the plants.

The most commonly used tool for cultivation is therefore the offset disc harrow which cultivates to a relatively shallow depth. In some soils, however, the continued use of one tool, operating at the same depth will cause a plow sole to be formed, and it is usually beneficial to do at least a part of the cultivation with a springtooth, a cyclone or similar tool, working at a depth even less than that of the disc.

The area between the plants in the rows

can be cultivated with a horse-drawn grape hoe, or a mechanized type of hoe that works in a similar manner. Several types of mechanized hoes are offered on the market, some of which can be operated by the tractor driver and some of which require additional operators. Regardless of the type, considerable skill is needed in manipulating the blades in and out of the rows to avoid injury to the plants. All mechanical hoes now being used have the additional disadvantage of being difficult to regulate as to depth. Contours of the soil surface between the rows do not always correspond exactly with those of the soil surface within the row.

In some plantings, hand hoeing is practiced.

For plantings where no trellises are required, and where there is wide spacing of the plants (usually 8×8 feet or more) disking both directions is usually suffi-



This planting was laid out with rows far enough apart to allow disking under weeds and prunings between the plant rows.

cient, except for breaking up plow sole that might be formed.

In general, growers should cultivate as infrequently as possible. Cultivation is needed only for the purpose of controlling weeds, to prepare the soil for irrigation, or to disk under prunings (see page 33).

Mulching blueberries. A mulching system for blueberry plantings has been satisfactory in the New England states.

For unirrigated plantings, mulching offers some advantages. If the mulch is applied several inches deep it will keep

down weeds, keep the soil cooler in summer, help to retain soil moisture, and help to control erosion.

The mulch may be applied around each plant, or over the entire surface of the soil. Sawdust, straw, or hay may be used, but it is well to avoid mulching material that contains weed seed.

Where material low in nitrogen is used, it may be necessary to apply 2 or 3 times as much nitrogenous fertilizer.

Alfalfa hay, which contains about 2.5 per cent nitrogen, is recommended where the cost is not prohibitive.

Weeds can be controlled by spraying, in some cases

Oil sprays have been used for the control of weeds in plantings of trailing blackberries in the central valley. Diesel or fuel oil is commonly used.

A common rate of application is 20 to 50 gallons, plus enough water to bring the total volume to 100 gallons.

For the control of annual grasses and broad-leaved weeds, a mixture of 20 to 30 gallons of oil per 100 gallons of spray is needed. To retard the development of Johnsongrass, 50 gallons of oil is needed. If 1 quart of dinitro ortho secondary butyl phenol is added to the 20- to 30-gallon oil spray, the mixture will be a more effective general weed control than the oil alone. Several companies are offering fortified oil sprays.

Application of any of these sprays in a berry planting should be made under a pressure of 50 to 75 pounds per square inch. The nozzles should direct the spray very low for the weeds between the rows, and be pointed directly at the weeds near the bases of canes within the rows.

A pressure of 100 pounds per square inch may cause the spray to drift and reach the berry vines. This should be avoided.

New materials are being tested for the control of grasses in bushberry plantings, and while they give promise, specific recommendations for their use cannot be given at this writing because of insufficient data. Two such materials are isopropyl normal phenyl carbamate (IPC), and trichloroacetate (TCA).

Irrigation is important—plants need water throughout the year

Irrigation should aim at maintaining the available soil moisture throughout the root zone (4 to 6 feet) at all times of the year, for plants of all ages.

The most frequent applications of irrigation water are needed during the picking season. In the San Joaquin Valley, irrigation may be needed as often as once

or even twice a week during this season. During cooler seasons, and in cooler areas, irrigation may be needed as little as once a month, or even once every 2 months.

As stated before, the roots of berry plants tend to spread out for a considerable distance on either side of the rows.

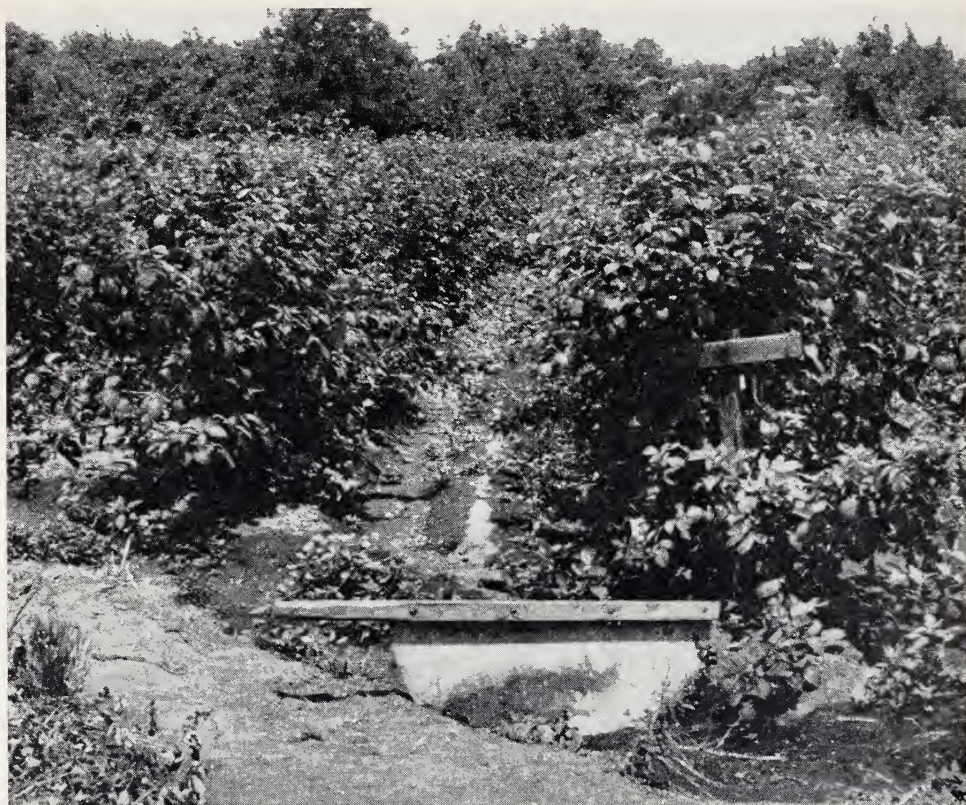
It is therefore desirable to get irrigation water to all of these roots so that as much of the root population as possible can remain active. Irrigation that does not reach at least a major portion of the feeding root population prevents the plants from utilizing a substantial portion of the soil moisture and plant nutrients which would be potentially available in the location. The plants therefore produce less growth, less vigorous growth, and less fruit than they might.

Many growers use two furrows per plant row (see photo, below). The centers of the furrows are approximately 2 feet from the centers of the plant rows. In some soils, and in very level locations, water in these furrows may spread laterally to a sufficient extent to wet the entire soil mass. In many locations, however, the water will not spread more than a

foot or so on either side of the furrows and will not reach enough of the root population.

In such cases, the flooding system of irrigation is probably better. The checks or borders for flooding irrigation should be located in the plant rows and at the ends of the rows. While a much more uniform distribution of water results from this system, it can only be used on soils that dry out quickly at the surface, to permit picking operations within a few hours after irrigation.

There is a considerable difference of opinion regarding the use of sprinkler irrigation on bush berries and it is not within the scope of this circular to discuss sprinkler irrigation. It seems appropriate to mention, however, that one grower in the Watsonville area uses sprinkler irrigation for trailing blackber-



Irrigating raspberries by means of furrows close to the rows. Note tappoon used to dam the water in the head ditch.

ries and has experienced no difficulties as to quality of fruit, on the vine, in transit, or in the processing plant. Sprinkling is done during warm, clear days so that the berries and vines dry off before evening.

When it is necessary to plant on shallow soil, or hardpan land, the only way to avoid injury from the accumulation of free water on the underlying parent material or hardpan (see page 20) is by the regulation of the irrigation water. This can be done by breaking up the runs into very short distances. The irrigation can be further controlled by careful leveling of the land, or by running the furrows or plant rows on the contour.

If short, level runs are provided it will be possible to fill the furrows quickly and

then shut off the supply of water in them so that a limited amount of water can be applied uniformly throughout the length of the furrow. Apply only enough water to saturate the soil down to, or close to the parent material or hardpan.

It is still possible for rainfall to cause injury on hardpan land by accumulated water, but as stated, in such a case artificial drainage must be provided.

Since no general rules can be given for the rate and frequency for the application of irrigation water, nor the man hours required to irrigate, it might be well to repeat that in any irrigation, the aim is to maintain the available soil moisture, at all times of the year, throughout the entire soil mass, to a depth of 4 to 6 feet.

Pruning and trellising is a major part of the work involved

At planting time. Bush berries usually need some pruning at the time they are planted.

Trailing blackberries and black and purple raspberries should have the woody parts of the cane removed, if the plants are in good condition. If the plants have been weakened through partial drying out or other causes, it is better not to prune before planting and flowers should be removed as soon as they form, the first season. In either case a higher percentage of survival will result.

In the case of red raspberries and upright blackberries, vigorous canes may be cut back to about 18 inches; less vigorous canes should be cut back more severely.

Vigorous plants of currants and gooseberries may be headed back (i.e. cut) to 12 inches. Weaker plants should be headed back to 6 inches.

All weak wood and fruit buds on blueberry plants should be removed at the time of transplanting.



Left to right: a Crandall blackberry before pruning; the same bush after being well pruned.

And every year. Berry bushes need pruning every year, to encourage the growth on which the greatest number of fruit will be borne, and to eliminate less desirable parts. The following is a discussion of pruning methods recommended for various types of berries:

Trailing blackberries. The operations of pruning and of putting canes on trellises are so closely allied, for trailing blackberries, that they will be discussed as one operation here. For a discussion of types of trellises, see page 33.

In practice growers have observed that the largest fruits are borne near the base of vigorous canes, and on spurs 15 inches or more in length, so pruning systems aim at preserving short, vigorous canes, and developing long, stout, fruiting spurs.

Since there are no fruiting canes formed until toward the end of the first growing season, no fruit will be harvested, and no pruning of fruiting canes will be necessary the first year. The vegetative canes should be pruned during July or August in the same manner as for older bushes (see below).



On two-year-old, or older bushes, pruning should be done as soon as the harvest period is over (usually July or August). Pruning consists of cutting off the old fruiting canes and removing them from the trellis. Old fruiting canes should be cut off very close to the surface of the soil.

Cutting may be done with hand shears, with a pruning saw, or with mechanical hedge trimmers. The power unit for mechanical hedge trimmers may be mounted on a carriage and wheeled along the rows. The pruning saw (very popular in the San Joaquin Valley) may be used for cutting off the canes and is also valuable for stripping the canes off the trellis wires.

No matter what instrument is used, care should be exercised to prevent injury to new canes when cutting the old ones.

Approximately 3 to 5 man days per acre are required to remove old canes from the trellises, when using a pruning saw.

When the old canes have been removed the next immediate step is to place the new canes on the trellises. This is usually done in either of two ways.

The most common method used on close spacings (plants 4 feet apart in the row) is to head the canes back to about 7 or 8 feet in length. Canes are then arranged on the trellis one at a time, giving a sort of fan-shape to the plant as shown in the photo on page 30.

For security against wind, the canes should be tied into the trellis by weaving them in behind other canes from the same bush, and from adjacent bushes. *It is not good practice to twist the canes around a single wire for any distance*—this makes them too difficult to remove after the harvest and harder to cover with spray materials.

The other common method of trellising is used on wide spacings (plants 8 feet apart or more in a row). In this case, canes should not be headed back as is recommended for close plantings. Canes

should be 10 feet or more in length so that they may be laced in with canes from adjacent plants, otherwise there will be blank spaces on the trellis and a danger of the wind loosening the canes.

While it is more difficult to avoid bends and breaks in the canes, and more time is required per plant to handle long canes, the number of man hours required per acre to put them on trellises is about the same as for shorter canes because there would be fewer plants per acre in the wide plantings.

A word of caution about bending the canes. Too sharp a bend will cause them to break. The extent to which the movement of water and manufactured food material is restricted by these breaks is not known, but it seems obvious that such a condition is not normal. So while it is probably impossible to eliminate bends

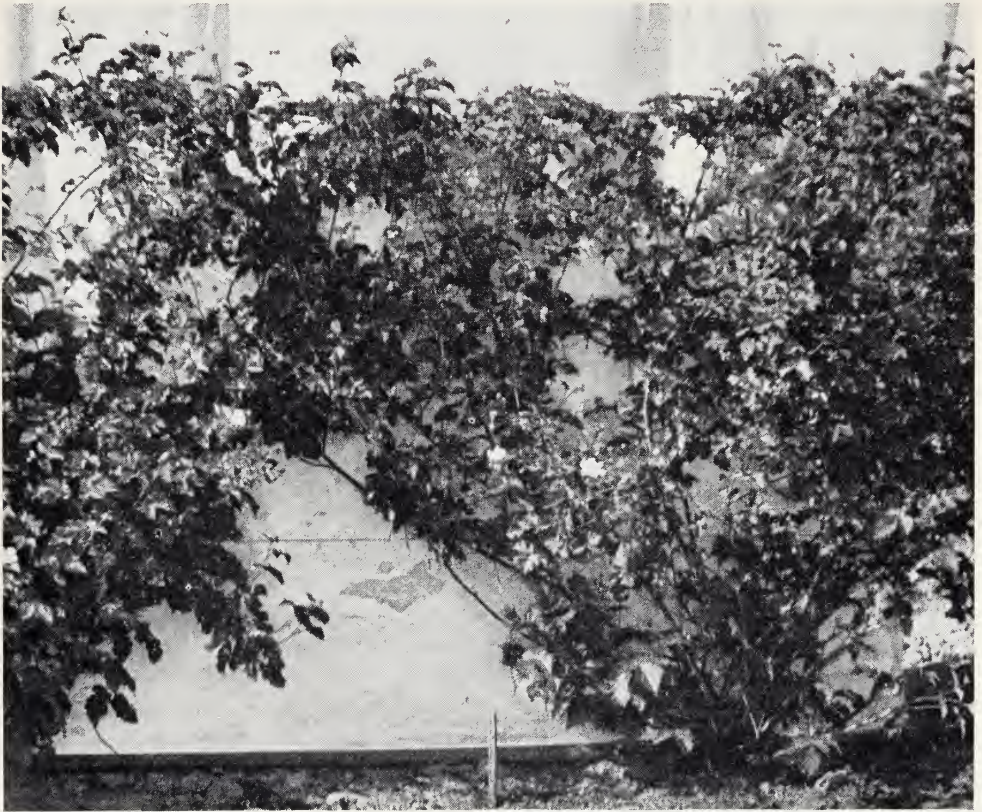
and breaks entirely, the pruning crew should be watched closely to keep this type of injury to a minimum.

Laterals will develop from the canes on the trellises, during summer and early fall. They should be headed back to 15 inches, during early fall. Some laterals may be used to fill in vacant spaces on the trellises.

Erect blackberries. The actual pruning of the canes which will fruit the following season is rather a precise practice with erect blackberries. From 4 to 8 vigorous canes should be retained, and the others removed. All varieties are usually summer pinched at a height of 5 feet.

Varieties can be grouped into three general classes for treatment of the other pruning operations, as follows:

1. Varieties - (such as Lawton and Ward) that have fruiting buds near the



Fan-shaped pruning, used in the San Joaquin Valley, with 3-wire trellis for trailing blackberries.



Trailing varieties are often woven in loose spirals on a 2-wire trellis, taking care not to bend the canes so they will break. It is felt that breaking the canes will damage the bushes.

base of the lateral branches, and well down on the canes. Fruiting clusters are rare on the 5 buds nearest the tips of the lateral branches, and the number of buds per branch is usually 8 to 12. These plants should be cut back moderately, removing up to one half of each lateral branch.

2. Varieties (such as Early King and Taylor) that have fruiting buds nearest the tips of the branches. The terminal one third of branches should be headed back. This means that approximately the terminal 5 or 6 buds will be removed by pruning. Any unbranched canes should be cut back to a height of 5 feet.

3. Varieties (such as El Dorado and Mersereau) that have buds scattered along the production wood. The branches should be shortened approximately one half to reduce the number of berries and to increase their size and the vigor of the plant.

Red raspberries. As soon as possible

after the harvesting period, prune out the old fruiting canes and place the new canes on the trellis.

Some cane thinning is done by some growers, but there seems to be no exact pattern followed with regard to the number of canes per lineal foot of row.

Black and purple raspberries. When new canes reach a height of 28 inches or more, they should be pinched or cut back to approximately 24 inches. This will tend to make them develop lateral branches on which fruit for next year will be borne.

After harvest, remove all old fruiting canes by cutting as close to the soil surface as possible.

During the dormant season 4 to 8 vigorous canes are selected for each plant and the others are removed. The branches of unsupported plants should be headed back to approximately 4 to 7 inches, for one-year-old plants, or to 8 to 12 inches

for plants that are 2 years old or older. In general, vigorous, healthy canes can support more fruiting wood than weaker canes.

The canes of purple raspberries should be headed back as described for black raspberries, but if these raspberries are grown on a trellis, the supported canes can be allowed to grow to about 30 or 36 inches before being topped.

Currants and gooseberries. During the dormant season following the first season of growth, the weaker shoots should be removed, leaving 6 to 8 strong shoots.

At the end of the second year, 3 to 4 one-year-old shoots, and 4 to 5 two-year-old shoots should be left.

At the end of the third year, and every year thereafter, 3 to 4 each of one-, two-, and three-year-old shoots should remain on the plant.

Blueberries. During the first 2 years after transplanting, blueberry bushes need only a light thinning out of the weaker branches, and a removal of the fruit buds to keep the bushes from bear-



A well shaped, 3-year-old bush of Jersey variety of blueberry.

ing fruit. The production of fruit during this period is not desirable, as it will tend to reduce the vegetative growth and delay the production of a commercial crop. Since the fruit buds are borne on the terminal part of the shoots, the terminal portion of these shoots (one-year-old wood) should be removed. If any fruit buds are missed in pruning, the flowers should be removed when they blossom.

On plants 3 or more years old, only very general recommendations can be given for pruning:

Stems that are 3 to 4 years old tend to produce short, weak shoots and small berries—cut them back, and remove a few.

Remove branches that are nearly horizontal—the weight of the berries will cause them to lie on the ground.

Remove short, weak shoots that tend to crowd the stronger, more vigorous shoots.

Most varieties tend to overbear, so reduce the number of fruit buds on the shoots to 3 or 4—berries will be larger



Removing prunings from a planting of red raspberries.

and better, and the plant will produce better growth for the next year's crop.

Some varieties, such as Cabot, produce many fruit buds in relation to the number of leaf buds. The shoots should therefore be cut back one half to two thirds in order to leave the proper number of buds.

In addition, it is advisable to study the vegetative and fruiting responses of the plant as a guide to pruning practices.

Removing prunings. Blackberry and raspberry prunings are relatively soft and may be disked into the soil between the rows. While it is possible that such a

practice will tend to build up a population of insect pests and diseases, no detrimental effects have been observed in plantings where this is done.

The other alternative is to rake up the prunings, remove them to a place where they can be safely burned. This is a more expensive and laborious procedure, and does not appear to be justified.

Currant, gooseberry and blueberry prunings are relatively woody and are not readily incorporated into the soil by disking. Removal and burning is recommended.

Trellis types—the bush growth determines the size used

Trailing blackberries and red raspberries need trellises to support their canes in an upright position to facilitate pruning, spraying and picking. The type of trellis needed depends on the amount of growth attained by the particular bushes in the particular locality.

In the central coastal area, a single wire trellis is most common for unirrigated Logans, although a few growers use a 2-wire trellis with satisfactory results.

For other blackberry varieties, with normal amount of growth for the bushes, the most common are either 2- or 3-wire trellises. Only those growers having exceptionally vigorous bush growth use 4-wire trellises, and most of these are experimental in nature. The growers are not yet certain that the additional expense is justified by the presumably higher yields obtained.

Supporting posts should be of $2 \times 2''$ redwood. End posts for each row should either be larger ($6 \times 8''$ or $8 \times 8''$) or should be braced to take the pull of the wires. Posts should be long enough so that the top wire of the trellis may be laid on top of the post.

On a 2-wire trellis, the lower wire is from $2\frac{1}{2}$ to 3 feet from the ground, the top wire 4 to $4\frac{1}{2}$ feet.

On a 3-wire trellis the bottom wire is usually $1\frac{1}{2}$ to 2 feet from the ground, the middle wire 3 to $3\frac{1}{2}$ feet, the top wire about $4\frac{1}{2}$ feet.

A 4-wire trellis has the same dimensions as a 3-wire, with the exception that the posts are 7 feet long, so as to place a fourth wire on top, about $5\frac{1}{2}$ feet from the ground. This may be too high for a good many pickers.

On multi-wire blackberry trellises, the top and bottom wires should be galvanized No. 12 or 13, to support the weight. The center wire or wires can be No. 14.

For raspberries, a special trellis is generally used, with 2 wires on cross-arms, about $3\frac{1}{2}$ to 4 feet above the ground, and about 15 inches long. A second set of wires is then strung on crossarms of the same length, or on either side of the posts, about 2 feet from the ground. No. 14 wire is strong enough.

In all cases, the spacing of the stakes depends on the spacing of the plants in the rows. The stakes should be approximately 16, 18, or 20 feet apart.

Erect blackberry trellis system consists of a separate stake for each bush. Wire hoops or barrel hoops are fastened to the stakes so that the canes can be confined and held erect.

As part of the trellising system, it would be well to mention the handling of new canes that grow out from the base of the bush while the canes on the trellis are bearing. Since these new canes will bear next year's fruit, they must be protected. Pin them back in the row, parallel to the trellis, below the fruiting canes.

There is no experimental evidence to indicate that bush berries respond to any fertilizing agent other than nitrogen.

The first season following transplanting, the young plants are just beginning to establish root systems and are highly susceptible to injury from fertilizer, so light applications, or none at all should suffice. This is particularly true of young blueberry plants.

Established plantings will usually respond to applications of nitrogen as follows: A spring application can be made during January or February, to increase the leaf area and the fruit size. This application may also have some residual effect on the vigor of the vegetative growth of new canes.

For plantings which are low in nitrogen, a second application may be made during April. This application will affect primarily the vigor of new shoots or canes.

A third application may be made during July, and will affect mostly the fruit-bud differentiation which takes place during the latter part of the summer for all bush fruits. This application may also have some residual effect on the development of laterals of blackberries and black and purple raspberries.

The amount to use, split between the various applications, will vary with the specific site on which the berries are grown and no general recommendations can be made. It varies between 50 to 100 pounds of actual nitrogen per acre on

Split redwood stakes, or small box cleats should be used to pin the new canes in place and keep them from being trampled on by the pickers. If this precaution is not taken, they may grow up through the fruiting canes or between the rows and present a problem at picking and pruning time.

Fertilizer—nitrogen gives the desired results to berries

heavy soils, to as much as 200 pounds per acre on light soils. It would be well for the grower to establish a series of test plots to determine how much fertilizer is needed for his own plantings. Many County Farm Advisors are cooperating with growers to help determine fertilizer needs.

Several forms of nitrogenous fertilizers can be used—ammonium sulfate, ammonium nitrate or liquid ammonia are the most commonly used. In general, it can be recommended that fertilizers containing sodium be avoided because this element is already present in relatively high quantities in many locations throughout the state and the addition of more sodium may injure the plants.

Broadcasting fertilizer over the entire surface of the soil between the plant rows seems to be the best method of application, and least likely to cause injury to the plants. This is only possible, however, when flood or sprinkler irrigation is used.

Where furrow irrigation is used, the fertilizer can be drilled directly into the furrows. For better distribution within the furrows, it is well to remove the shoes from the drill. But in any event, the fertilizer will be distributed in a rather narrow band, and the application of heavy rates of fertilizer by this method may cause injury to the roots in the immediate vicinity of the application. Any equipment or method of application that will give wider distribution will tend to decrease the danger of injury.

Diseases—most of them can be controlled by timely spraying

The heavy annual pruning given to most berries, and the removal of old wood and such new wood as shows signs of disease, tends to check some of the trouble caused by diseases common to bush berries. Then too, since most bush berries are relatively short-lived, and plantings are removed and replanted at regular intervals, permanent infestation of a given piece of ground is usually avoided.

When certain diseases occur in a planting, it is sometimes cheaper to pull out all of the old plants and reset with new, healthy ones, than to try to combat the disease by spraying and other preventive measures. But on the whole, most troubles can be controlled by spraying.

There are several serious diseases that are injurious to berry plantings and will reduce yields and quality, and in some cases, shorten the life of the planting. The following is a listing of the diseases to watch for, and where known, the recommended control measure to take.

Anthracnose occurs on raspberries and blackberries in the eastern states, but is not common in California. It is caused by the fungus *Elsinoe veneta*.

Typical effects of leaf spot on blackberry. (From Bul. 218.)



Look for white spots with purple borders on the leaves, and similar but larger spots on the canes of black raspberries.

What to do. This (and some other cane diseases) may be treated with winter-strength lime-sulfur solution—8 gallons of liquid lime-sulfur to 100 gallons of water. Bordeaux mixture (5-5-50 strength) applied just before the buds push out, and again as a summer spray (3-2-50 strength), after the leaves are out, should aid in control.

Remove the old canes after they are pruned (don't disk into soil), and spray the bases of the old canes, the new canes, and the surrounding soil thoroughly.

Cane and leaf spot, caused by the fungus *Septoria rubi*, sometimes attacks the Boysen, Logan and Young varieties of blackberry. (This disease should not be confused with leaf spot on raspberry, caused by *Cylindrosporium rubi*, which does not occur in California.)

Look for small dead spots, with brown, or reddish-brown borders that appear on the leaves. Affected plants will decline in yield and the berries will be smaller. The disease may be severe on Mammoth, Cory and on wild Pacific Coast blackberries. The fungus is spread by splashing water and is likely to be severe around Santa Cruz County, or in other areas in years when there are late rains.

What to do. No satisfactory method for control has been reported. Application of 4-4-50 bordeaux mixture in the dormant season may help. Some growers remove and burn all diseased canes immediately after harvest.

Cane blight is not serious in California. It is caused by the fungus *Leptosphaera coniothyrium*.

Look for dead areas of brown color that appear on the canes. The canes are often girdled and killed. Young berries

sometimes dry up prematurely. This disease is most common on black raspberries.

What to do. Treatment is the same as that given for anthracnose.

Cane dieback is aptly described by its name. It occurs on trailing varieties of blackberries, and is quite common throughout the state.

Look for buds that fail to break at the beginning of the growing season. On each plant can usually be found a progressive series of development, from those buds which fail to break, to those that develop normally. None of the stages below normal development produces satisfactory fruit.

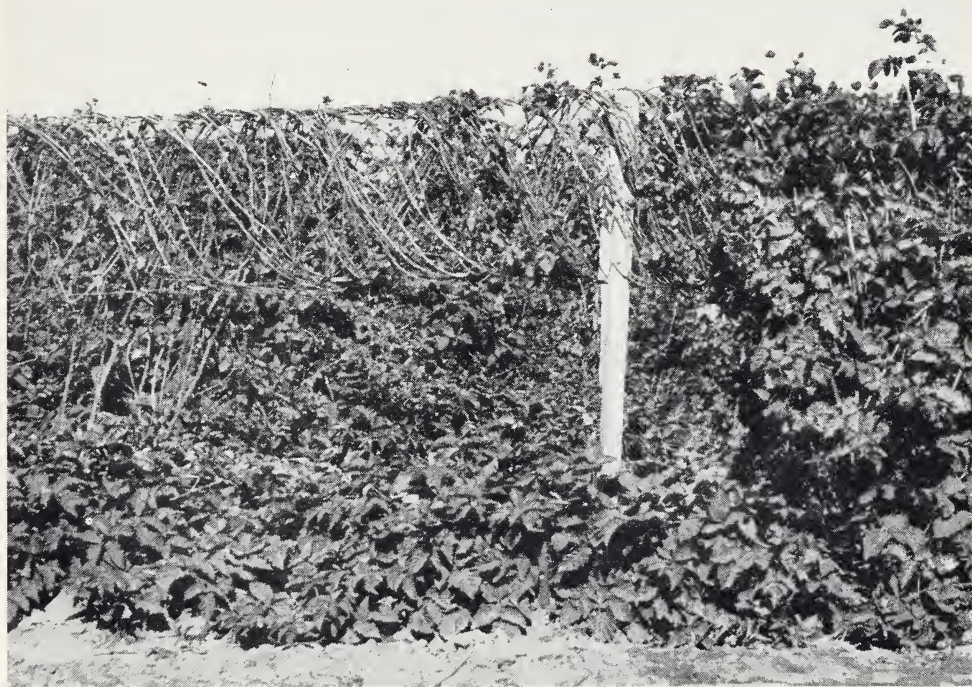
Some buds produce only a few inches of growth and eventually wither and die fairly early in the season. Those buds that produce fruiting laterals from 4 to 12 inches long generally show marginal scorch, and scorched areas appear throughout the leaf surface without any definite pattern. Nearly all leaves are

small, and the chlorophyll has a mottled appearance.

The flowers are borne on lateral growths which, in most cases, are too short, and the leaf area is too small to support development of large fruits. Hence many of the fruits become mummified when they are small. Most of the buds near the ends of the canes fail to break, or produce only short growth which soon withers and dies. When the entire terminal end of the canes consist of such buds, the result is the appearance of typical cane dieback (see photo).

What to do. Check to see that adequate soil moisture is being maintained to a sufficient depth throughout the year.

While this is not certain to check cane dieback, the suggestion is based on the fact that the only trailing blackberry plantings observed in the state that have been nearly free from dieback symptoms are in the vicinity of Fresno. They are planted on soil that is over 8 feet deep, sandy in texture, and with a very high



This shows the typical effect of cane dieback on Boysen in the Watsonville area;

rate of water penetration. The operators maintain adequate soil moisture throughout the entire area and the plants do not suffer from an excess or a deficiency of soil moisture at the surface, or at any depth, at any time of the year. The irrigation practices on these plantings seem to be the only important factors in which they differ from plantings in which die-back is mild or severe.

Other factors may be found to be the cause for this disease. Local Farm Advisors should be consulted regarding the progress of research on it.

Crown gall, one of the most serious diseases of brambles, is caused by the bacterium *Agrobacterium tumefaciens*. It usually weakens the plant, and may ultimately kill it.

Look for a warty growth on the roots, or large galls on the crown of the plant.

What to do. Avoid tillage wounds, as far as possible.

The galls may be cut out and the wounds disinfected with corrosive sub-

limite (1 part to 1000 parts of water), but this treatment is not very practical on a commercial scale so removing and replacing badly infected plants is recommended.

Dwarf or rosette is a virus disease causing marked reduction in growth and productiveness in Logan, Mammoth and Phenomenal varieties of blackberries. Affected plants usually become unproductive and unprofitable within a year.

Look for a marked yellowing, downward cupping and reddening of the leaves, dwarfing of the cane growth and unproductiveness.

What to do. Dwarf is caused by a virus which may be carried by insect vectors going from diseased to healthy plants. Once the plants are infected, there is no cure.

The virus has been recovered from the wild Pacific Coast blackberry, so it would be well to get rid of any wild blackberry patches in the vicinity.

Then too, the Boysen, Young, and



and this shows effects of the same disease on a planting in Tulare County.

Himalaya varieties seem to be relatively resistant to dwarf, so where the disease makes the removal of a planting necessary, it is suggested that these varieties be substituted for replanting.

Fruit mold, caused by the fungus *Botrytis cinerea*, occurs mostly in moist weather, and on berries that remain wet with dew or rain for prolonged periods.

Look for fruit that decays on the bushes—especially on Logans—and a gray, dusty mold.

What to do. Fruit mold can usually be avoided by adequate spacing of the canes on the trellises, so that the berries will dry off quickly after wetting. Do not pick berries when wet. Pick closely to avoid over-ripening, and remove all moldy fruits.

Oak fungus (*Armillaria mellea*) attacks and kills brambles in some districts. It affects the plants by destroying the roots.

Look for plants that wilt and recover for a short time, or collapse and die suddenly. The disease develops from a center, spreading year after year. Under the bark the fungus develops large sheets of white or creamy mycelium (spongy growth). The roots become watery and soft and finally decay. The decayed bark has a rather agreeable, mushroom odor.

What to do. Remove all diseased plants, and at least one healthy plant on either side of each diseased plant. This will help check the spread of the fungus. Be sure to remove *all* affected roots to a depth of 2 to 3 feet.

A system of disinfecting the soil with carbon disulfide has been worked out. The local Farm Advisor should be consulted for details.

Orange rust (not to be confused with raspberry leaf rust) is troublesome in the coastal berry-growing districts where the Pacific Coast blackberry grows wild. On affected plants the fungus lives over the winter within the plant tissues, including dormant buds and cane tips.

Look for light yellow color on the shoots. The shoots are often spindly during the spring months, and later many rust pustules (small eruptions) develop from the infected tissues.

What to do. The wild blackberry, the Crandall and the Young are severely attacked, while the Logan is less severely affected and the Himalaya only slightly. Apparently the Boysen is not affected at all, even when nearby Young plantings are badly diseased.

Dig out and burn plants when the disease first appears in the spring, and replant with Boysens. Diseased wild blackberries growing in the locality should be removed. All growers troubled with this disease should cooperate in getting rid of diseased plants in order to avoid its spreading.

Powdery mildew often affects currant and gooseberry plants. It is caused from infection by *Sphaerotheca morsuvae*. Another powdery mildew, *Sphaerotheca humuli*, may severely attack the fruit and foliage of raspberries.

Look for a whitish, powdery growth on new leaves and shoots. The disease will reduce the vigor of the plants and ultimately decrease the crop.

What to do. Cut off and burn infected shoots during the pruning season. Rake and burn all leaves.

In the spring, when the buds of currants and gooseberries are beginning to swell and break, spray with dormant-strength lime-sulfur solution (1 gallon of liquid lime-sulfur to 10 gallons of water). Cover all shoots thoroughly with the spray.

Raspberries may be burned by sulfur dust and lime-sulfur, even with summer strength, applied during the summer. These materials are therefore considered unsafe for treating mildew on raspberries. Further tests are needed to find a safe and effective treatment for mildew on raspberries.

Raspberry leaf rust, caused by the

fungus *Phragmidium rubi-idaei*, attacks raspberries only.

Look for small, light yellow pustules, usually on the underside of the leaves; later black spores form. On Ranere, the attack is usually confined to the older leaves, but along the coast the disease may practically defoliate the plants in late summer.

What to do. A cleanup of all leaves and a spray as outlined above for powdery mildew is recommended, but a sure way of controlling this disease is not known.

Salinity is caused by excessive amounts of neutral salts in irrigation water or in the soil. It will seriously damage or even kill berry plants.

Look for marginal scorch on the leaves, or a burning and drying of entire leaves. Eventually the entire plant will be affected and die.

What to do. Replace saline irrigation water with water of better quality, or select a new site for the planting where this problem does not exist.

Some saline soils need to have a better drainage system installed, after which the excess salts may be washed out with the aid of sulfur or gypsum.

Growers should also avoid excess irrigation that may contribute to poor drainage.

Spur blight, caused by the fungus *Mycosphaerella rubina*, causes canes to bear fruit near their tips only. It is not a serious disease in California.

Look for diseased tissue about the base of the buds, which turn brown early in the season. The buds stop growing and shrivel up. The entire lower part of the cane may become dark purplish brown.

What to do. When the young canes are 8 to 12 inches long, spray with a weak bordeaux (3-2-50, plus 2 pounds of resin fish oil soap). Follow this with a second application about 2 weeks later. Only the young canes should be treated.

Verticillium wilt is a soil-borne dis-

ease caused by the fungus *Verticillium albo-atrum*. It is widespread in California soils where susceptible crops, such as tomatoes, potatoes, and cotton have been grown. The disease may attack certain berry crops such as Boysen, Young, and raspberries. It affects the fruit, wood, and new shoots of berries, primarily.

Look for wilting of the leaves, followed by interveinal yellowing and burning of the leaves. Growth of the canes is stunted. This wilt is most serious during the first and second fruiting seasons. The canes usually die back from the tips, continuing down to the base.

Canes put on the trellis in the summer or fall may appear perfectly healthy, but by the next spring a considerable number of them may be dead. New shoots may push out from the base of fruiting canes and become diseased later on.

What to do. No effective method of eradicating this disease is known at present.

Control consists of growing the more resistant varieties, and not planting the more susceptible varieties following a crop of tomatoes, potatoes, cotton, or other host crops.

The resistant varieties are: Logan, Himalaya, Mammoth and Cory Thornless and the Cuthbert raspberry. Susceptible varieties include: Boysen and Young, and raspberries other than Cuthbert.

Virus diseases of raspberries have troubled eastern raspberry growers for many years. C. W. Bennett discusses them as follows:

"There are apparently at least five distinct virus diseases of raspberry. The names curl, red raspberry mosaic, mild mosaic, yellow mosaic and streak have been used to designate these troubles. With the exception of streak, all of these diseases have been transmitted by means of aphids. . . . The most satisfactory control measures for virus

diseases available for general use are: (1) careful and efficient roguing and (2) selection and production of virus-free nursery stock."

Some of these virus diseases, and others less well known, are serious in California as far as raspberries are concerned. The dwarfing virus (explained

above) has been troublesome on the Logan.

With the free introduction of berry plants from other states there is a considerable danger of bringing new virus diseases into California, so great caution is recommended in buying raspberry plants that must be brought in from any place outside California.

Table 7—Response of Brambles to Field Diseases

Disease	Response	Varieties
Dwarfing virus disease	Resistant	Young, Boysen, Himalaya
	Susceptible	Logan, Mammoth, Cory Thornless, Wild Pacific Coast Blackberry
Verticillium wilt	Resistant	Logan, Mammoth, Cory Thornless, Wild Pacific Coast Blackberry, Himalaya
	Susceptible	Boysen, Young
Orange rust	Resistant	Boysen, Himalaya
	Susceptible	Young, Logan, Crandall, Wild Pacific Coast Blackberry

Source of data: After Stephen Wilhelm, Division of Plant Pathology, University of California.

Insect pests—the right spray schedule helps here too

A number of insects and mites attack bush berries in California. The following pages discuss the more common pests and the measures best adapted for controlling them.

The blackberry mite (redberry disease), a microscopic spider mite, *Eriophyes essigi*, attacks Himalaya, Cory Thornless, Mammoth, Evergreen, and Crandall blackberries, and red raspberries in many sections of the state. Berries attacked by this mite grow to normal size, but do not ripen. All or part of the drupelets remain red and hard. Drupelets of the Boysen, Logan and red raspberry re-

main yellowish green, instead of turning dark red.

The injured fruit is unsalable and has little value for home use.

Control has been effected by spraying with a lime-sulfur solution (6 gallons of lime-sulfur solution to 100 gallons of water) when the leaf buds are beginning to open in February or March, in those areas where the mite is present.

Summer control may be obtained by spraying with summer oil emulsions, but this material causes the fruits to become leathery.

Consult the local Farm Advisor to determine if the mite is active locally.

Cane skin miners sometimes attack the surface of berry canes, leaving a trail just beneath the outer tissues.

Control is usually taken care of by good pruning. In most cases the damage done is not enough to justify other control measures.

Canker worms are sometimes troublesome on the Boysen, Logan and other berries. The fall canker worm, *Alsophila pometaria*, and spring canker worm, *Paleacrita vernata*, is found on berries at times.

Look for small worms, about an inch long, that feed on many kinds of plants, including leaves and fruit of berries. When the worms are disturbed they drop a silken web.

Control. Where control is necessary, spray with nicotine sulfate or with pyrethrum. Blackleaf 40 may be used at the rate of 1 pint to 100 gallons of water, along with a spreader or sticker.

Symptoms of attack by blackberry mite.



The currant fruit fly feeds on the pulp surrounding the seeds and completely hollows out the fruit of cultivated and wild currants and gooseberries. The fly is about the size of the common house fly, is orange or yellow in color, with green eyes and fine dark crossbands on the wings. The maggots are whitish and subcylindrical. At maturity they leave the fruit and pupate in the soil. The adults emerge from the soil in May and June.

Control methods for this fly in commercial plantings are not known at the present time.

The imported currant borer (*Aegeria tipuliformis*) attacks currants and gooseberries. This insect works in the heartwood of the branches or in the stem of the plant, either killing, or injuring these parts to such an extent that they break down under the weight of the fruit.

Control consists of watching carefully for the signs of this insect and removing and burning all infested parts, when pruning.

Nematodes in the soil are not an important pest on bush berries, but gooseberries along the north coast of California have been seriously damaged by *Aphelenchoides ribes*, a nematode that attacks the leaves. As a result, the production of gooseberries in that area has been reduced considerably.

Control for this pest is not known, but fortunately it is not found in very many gooseberry plantings.

The orange tortrix (*Tortrix citrana*) has attacked most kinds of bush berries in California. It starts to attack the buds and leaves in March and continues to attack the terminal foliage. When the fruit develops, this pest may attack the base of the berry, causing the berry to drop, or encouraging decay. The insect overwinters in the larval form on rubbish, or on the berry stems.

Control consists of spraying during the early growing season with DDT, used at the rate of 2 pounds of the 50 per cent

product to 100 gallons of water. Spraying should be completed from 1 to 3 months before harvest time so there will be no harmful spray residue on the fruit.

The raspberry cane maggot (*Phorbia rubivora*) lays its eggs in the leaf axils, or on tender tips of new canes. When the eggs hatch the larvae girdle the stems and mine spirally up or down the tender shoots just below the surface. This causes the tips to die—similar to the damage done by the raspberry horntail (see below).

Control measures have not been fully worked out. It is recommended that infested tips be pruned and burned.

The raspberry horntail often attacks raspberries and sometimes damages the Logan and Himalaya varieties of blackberry. The larvae girdle the tips of tender new shoots and cause them to wilt.

Control consists of cutting off the canes from a few inches to a foot below the evidence of wilt, or cutting back the tips until the burrow is no longer visible in the stem. After removal the canes and tips should be burned.

The raspberry leaf sawfly (*Priophorus rubivorus*) in some years may do serious damage to the leaves of raspberries, especially the Ranere variety, in Santa Clara County. The larvae eat the green leaf tissue between the veins.

Control is exercised by dusting with



Adult female of the raspberry leaf sawfly.
(From Hilgardia, Vol. 19, No. 2.)



Mature larva of the raspberry horntail.

$\frac{1}{2}$ per cent rotenone dust, applied at the rate of 50 to 75 pounds per acre, depending on the size of the plants. The dust should be directed upward from below to cover the underside of the leaves. Control with dusting should not be necessary, however, except in certain years and in a limited area in the state.

Red spider mites are among the most serious pests on the brambles. The common red spider, *Tetranychus althaeae*, the two-spotted mite, *T. bimaculatus*, and the Pacific mite, *T. pacificus*, become serious on all bush fruits in June and July. They cause the leaves to turn brown and fall off.

Control measures are being worked on and several new acaricides, which are relatively nontoxic to man, are now being introduced. The local Farm Advisor should be consulted regarding their availability and use.

Sulfur, which is used to control mites on tree fruits, may be hazardous when used on bush berries—especially raspberries.

The snowy tree cricket, *Oecanthus niveus*, occasionally damages raspberries by feeding on the flowers, resulting in deformed, worthless berries, or none at all. However, this insect is less serious on berries at the present time than was the case a few years ago.

Control measures include dusting with 1 per cent rotenone, applied at the rate of 75 pounds per acre. Even better control can be had with 5 per cent DDT dust,

at the rate of 40 pounds per acre, but the fruit must not be picked for 3 weeks following dusting to avoid toxic residue. No DDT residue is allowed by law, on raspberries.

Thrips occasionally attack the flowers and prevent the berries from forming properly.

Control can be maintained by the use of pyrethrum sprays, or with rotenone dust where the grower wishes to avoid the possibility of harmful spray residue on the fruit.

A pyrethrum and oil spray is safe to use: 1 gallon of summer-type oil emulsion, plus $\frac{2}{3}$ pint of pyrethrum concentrate, to 100 gallons of water. This should kill all active thrips on leaves, flowers and young fruit.

Miscellaneous insects that occasionally attack raspberries include: the blue sharpshooter, *Cicadella circellata*; Fuller's rose weevil, *Pantomorus godmani*; strawberry crown moth, *Aegeria rutilans*; strawberry leaf beetle, *Paria canella*. Of these, the most common is the strawberry leaf beetle.

Control of this pest may be had with DDT—allow about 2 pounds of wettable DDT per 100 gallons of water, or use 40 pounds of 5 per cent DDT dust per acre. Control should begin early in the blos-

For all operations preceding harvesting the grower has ample time to carry out each phase of the work, and relatively small crews are required. But when the berries are ready to be picked, careful timing is needed to insure:

1. Picking of the fruit at the proper stage of maturity.

2. An adequate supply of labor for the operations involved. This means continuous employment must be provided until the peak of the season, after which the crew must necessarily be laid off.



Damage of the strawberry leaf beetle to raspberry leaves. (From Bul. 505.)

soming season, and DDT should not be used less than 4 weeks before harvest.

The use of DDT may also be followed by an increase in trouble from red spiders. This insect is common on raspberries, but seldom attacks other bush fruits.

Poison dusts and sprays, such as cryolite dust or lead arsenate, cannot be applied safely until after harvest.

Harvesting berries requires careful timing of operations

Harvesting operations require more care and experience than any of the others.

Organize the work. The size of the operation determines how elaborate the organization must be. The chart on page 46 outlines the levels of supervision that might be used on a very large operation.

At the other end of the scale would be the case where the owner, or the owner and one assistant provide all of the supervision necessary to check on quality and quantities.



Picking operations in a Thornless Logan planting. Bushes in foreground

Delegation of authority for the various jobs that must be done is usually made something like this:

The pickers simply pick the fruit. When their crates are full, they carry the fruit to a shade shed near the end of the row (shade sheds may not be used in the cooler coastal areas) where the fruit is weighed and the picker is given credit for the load on his card.

The row boss is responsible for maintaining the crew at a specified size. He is also responsible for maintaining the quality standards of the pack, seeing that ripe berries are not overlooked, and that green or overripe ones are not included in the pack. There is a row boss for each crew of pickers.

The field checker is responsible for the maintenance of card records which show the number of crates picked by each picker, weighing and inspecting the berries and stacking them at the collecting point. There may be 3 checkers for 80 pickers.

The head checker collects all cards from the field checkers at the end of the

day, totals the number of crates picked (as shown on the cards) and audits the figures to see that they agree with the number shipped. In addition, the head checker may have other duties not specifically related to harvesting or checking, such as maintenance of a lost and found department for the several hundred pickers.

The foreman is in charge of field operations, over-all supervision of quality of fruit, maintenance of adequate supplies, personnel and the like.

The owner, in an operation demanding an elaborate setup as that described above, will probably not act as foreman, but will confine his work to over-all supervision of all operations. He will also be involved in negotiations with the processing plant and in relations with employment agencies.

The number of pickers needed at any time will vary as the season progresses, and according to the locality involved. The following are figures gathered from past experience in various parts of the state, on various kinds of berries.



are three years old; one-year-old planting on the hill in the background.

Blackberries. On the coast, at the beginning of the season, 1 to 2 pickers per acre are required; 3 to 4 pickers per acre at the peak of the season; 1 to 2 pickers at the end of the season. In the central valley, 1 to 3 pickers are required at the beginning of the season; 4 to 7 per acre at the peak; 1 to 3 near the end of the season.

The frequency of picking in the central valley and in the Sebastopol area is approximately weekly or biweekly; in Watsonville, every 5 to 7 days.

One workman can pick from 100 to 320 pounds of Boysens in an 8-hour day; he can pick about half as many Logans.

Red raspberries. At the beginning of the season, 1 picker per acre should be required, with 4 pickers per acre at the peak, and 2 near the end of the season.

One workman can pick from 30 to 100 pounds in an 8-hour day.

Currants can be picked over a period of 3 to 10 weeks, depending on the locality. One workman can pick 200 to 300 pounds in an 8-hour day.

Gooseberries. One workman can pick 300 to 400 pounds in a day.

Blueberries. One workman can pick 65 to 100 pounds of blueberries in an 8-hour day when the crop is heavy. This requires about 2 men per acre at the beginning of the season; 5 to 8 men per acre at the peak; about 2 per acre at the end of the season.

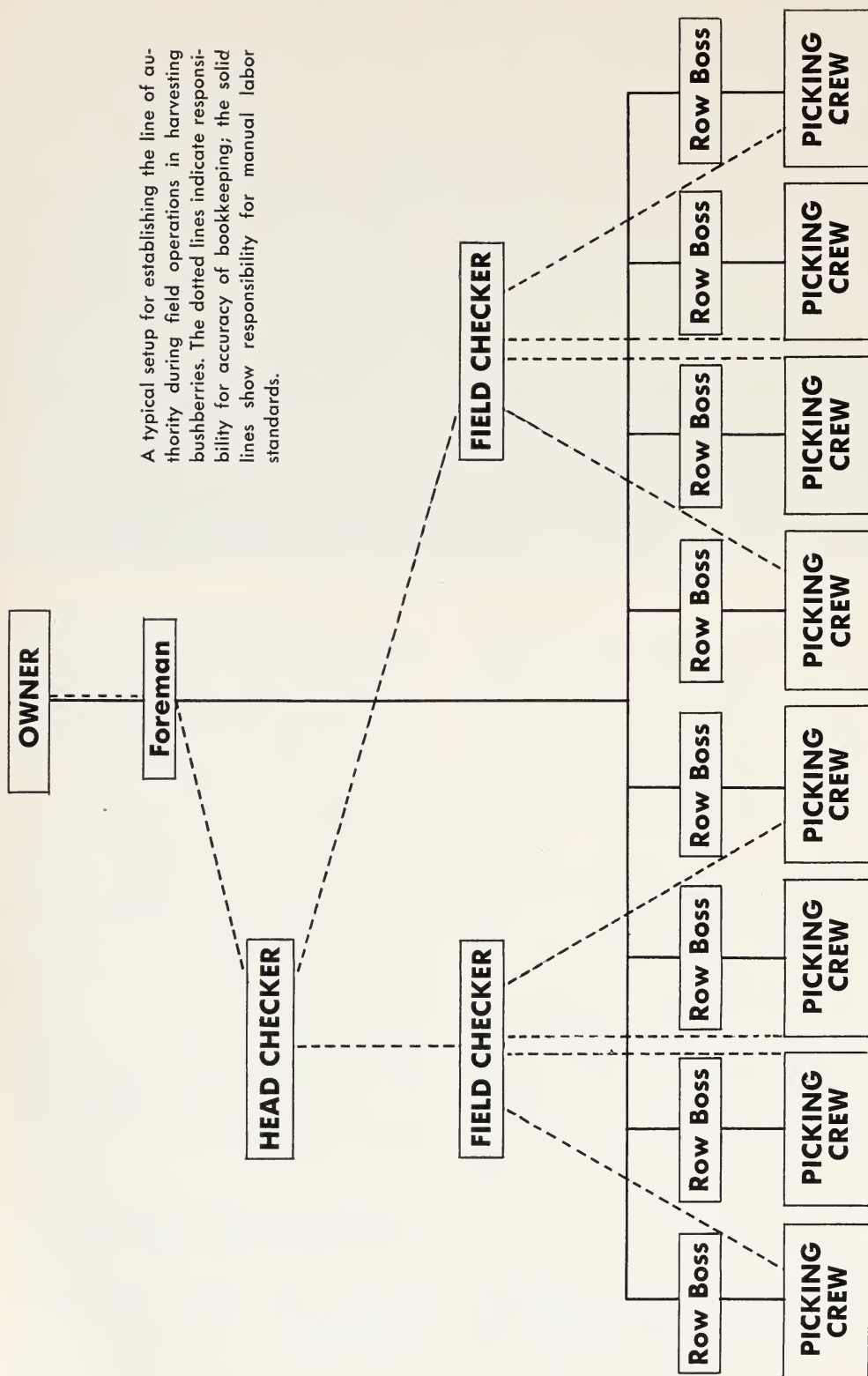
In order to estimate the size of the crew needed for the first picking, the operator may actually pick a few crates and calculate the requirements on the basis of the time required.

Equipment used in harvesting is varied, but rather simple

Baskets and crates are needed for picking blackberries and raspberries for the market. These are discussed more

thoroughly under the individual classifications below.

Shade sheds are needed at strategic



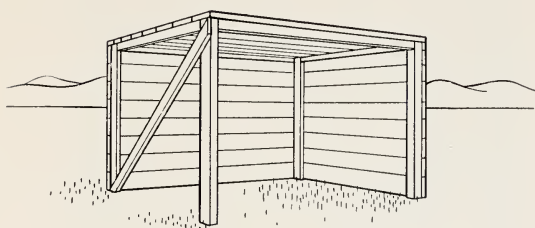
places in plantings in the hot central valleys. They need not be elaborate—just sufficient to provide shade from the direct sun on berries stacked there before being picked up by the trucks.

Carriers, with legs about 18 inches long, are handy for transporting the crates through the field, to the shade sheds, or collecting point. Their designs

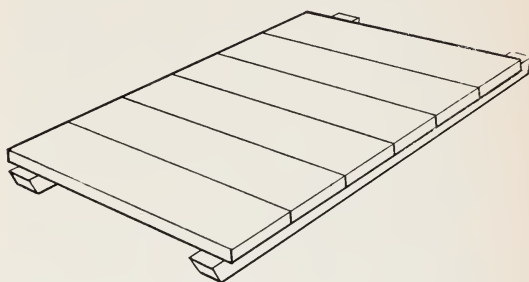
are quite diverse, each grower having his own ideas of what is needed for his planting. A suggested design is shown below.

Pallets may be needed for handling large quantities. The crates may be stacked up to 18 high on pallets and then moved with a lift truck, saving considerable labor at the processing plant or warehouse.

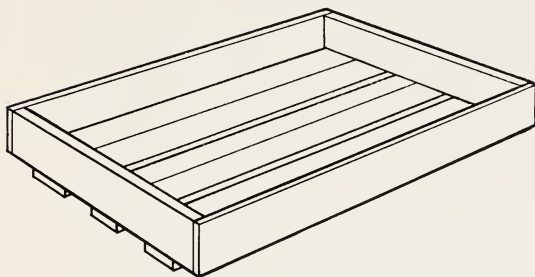
Here are a few of the pieces of equipment commonly used in harvesting and handling operations. While designs will vary, the ones shown here are simply suggestive of what has been used efficiently by some growers.



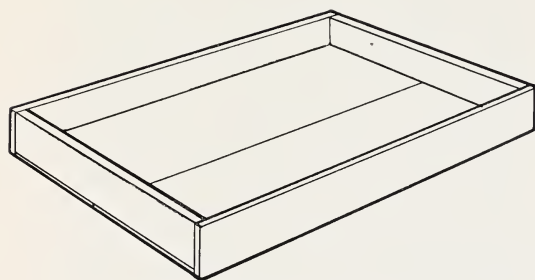
Shade shed



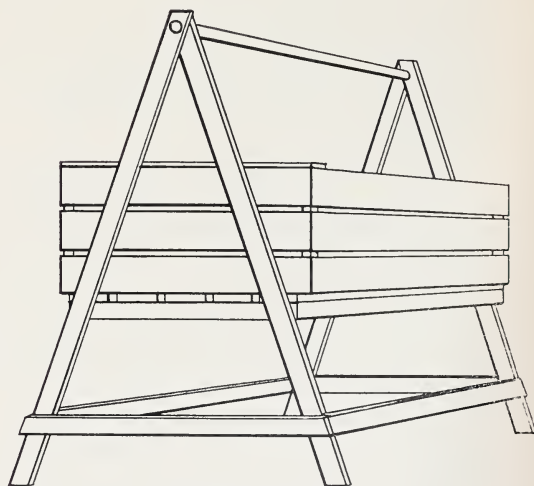
Pallet



Crate used for fresh berry sales



Crate used for sales to freezers



Typical carrier

Picking must be done when the fruit is in prime condition

Picking must be done at precisely the right time, when the berries are at the prime of condition for either the fresh market, or for processing. Since these conditions vary with different fruits, and with the purpose for which the berries are sold, they will be discussed individually below.

Trailing blackberries develop maximum flavor and sugar content at maturity, indicated by their turning from a reddish to a blackish-red color. Accurate determination of the exact stage of maturity for picking comes as a matter of experience. If the crop is sold to a processing organization, there will usually be field men available to specify and illustrate the exact stage of maturity required for processing.

The fruit is picked directly into crates with solid bottoms, with or without liners, when destined for freezing. For the fresh market, the berries are picked directly into baskets within crates.

The crates are taken, in carriers, to the shade shed, or other collecting point, weighed by the field checker, and left there. The picker is given credit on his card for the amount picked.

Periodically throughout the day, the berries at the field collecting points are picked up by trucks and delivered to their destination.

At the end of the day, the total number of crates on each picker's card is entered in a record book, and payment is made on this basis.

Erect blackberries attain almost full color before they are ripe. They are mature when the depression in the center of each drupelet is entirely filled.

Harvesting operations are the same as those described for trailing blackberries, above.

Red raspberries should be picked when they separate from the core with-

out crumbling. The entire planting should be picked at weekly intervals, in some coastal areas, but in the central valley it may be necessary to pick as often as every 2 days. There are no commercial raspberry plantings in the central valley at present, but results from experimental plantings indicate that picking should be done every 2 or 3 days in that area.

The berries may be picked directly into containers used for the fresh market, or into crates. In some instances they are picked into gallon cans, then sorted and graded as they are transferred into dry half-pint baskets. Sorting is usually done in the shade shed, or at field collecting points.

Sorting is not so necessary for local market shipments, but is essential for shipments going to eastern markets, where it is desirable to have berries of uniform maturity, in order to avoid spoilage in transit, and low quality of the entire shipment upon arrival.

Each container of red raspberries and blackberries has a minimum of 7 pounds of fruit. This weight refers to the 12-basket crate, holding 12 half-pint baskets.

Black and purple raspberries are not grown commercially in California, but harvesting of these varieties would be identical with that of red raspberries.

Weighing, handling and checking of raspberries, and payment of pickers is the same as for blackberries.

Currants are considered to be ripe when all berries in a cluster are full color. They ripen slowly, and can be held on the vine for a long time, in cool areas.

If the fruit is to be used for jelly, it should be picked while slightly under-ripe—at that age it contains more pectin. If the fruit is to be spiced, stewed, used for jam or any processing other than jelly making, it should be picked when fully ripe.

Do not pick berries from the cluster, as they are easily crushed. The stem of the cluster should be removed from the branches.

For fresh market use, strawberry crates and baskets are used. These weigh about 12½ pounds net. For processing, the fruit is picked into Los Angeles lugs.

Weighing and checking is the same as for blackberries.

Gooseberries are picked directly into Los Angeles lugs. If the fruit is to be shipped any distance, the lugs should be provided with tops.

For processing, the berries should be picked before they are fully ripe. The pickers should wear gloves as protection against the long, sharp thorns, and strip the berries off by hand, or use a scoop that resembles a cranberry scoop. The fruit picked by this method will be mixed with leaves, which may be removed by hand, or by passing it through a grain fanning mill, or a similar device.

For the fresh market, the berries must be picked when they are mature. This means that the entire planting must be picked over several times to obtain fruit at the proper stage of maturity. Hold the bush with a gloved hand, and pick with the bare hand.

For long-distance shipments, the 12-basket tray has been used extensively and has been found to be ideal.

The trays are provided with cleats on the bottom that fit into the ends of the tray below. This prevents end play, and when strips are nailed to the ends of a stack, there is practically no movement at all during shipment. The cleats also allow for ventilation.

Shipments of berries by truck or express are often reported in terms of carlots. In such cases, a carlot of berries consists of 1800 of the 12-basket trays.

Checking and payment for gooseberries is accomplished as it is for blackberries.

Blueberries do not ripen evenly within the cluster, and since it is necessary to pick only mature berries from each cluster, the entire planting must be picked over several times. However, the ripe berries will hold on the plant for a week or two, which allows some leeway.

The mature berries are a dark, rich, blue color at the stem end. A reddish tinge at the stem end indicates immaturity.

All of the blueberries grown commercially in California are usually sold on the fresh market. They are picked into gallon cans and then taken to the collecting point, where they are sorted. The immature or damaged fruit is removed at this time.

The salable berries are then transferred to 12-ounce baskets of the type used for strawberries. There are 12 baskets to the crate and each basket is covered with cellophane. Four crates are nailed together, one on top of the other, with cleats. A lid is placed on the top crate, and they are ready for shipment to the fresh market.

Checking and payment are the same as for blackberries.

Sales and shipping—the processes are fairly standard

The weight of 12 half-pint baskets is estimated at 7 pounds net, or about 8 pounds billing weight.

Several marketing organizations, or growers' cooperatives have been formed by berrymen as an aid to the orderly selling of crops. The purpose of these organizations is to help the individual to get his crop into the channels in which there is the greatest demand, and for which he will receive the best price.

Following is a list of the berry marketing organizations in the state:

The Central California Berry Growers'

Association, with headquarters in San Jose, is active in the 6 coast counties of Alameda, Santa Clara, San Mateo, Santa Cruz, Monterey and San Benito.

The Southern California Berry Growers' Association has its headquarters in Bloomington. In 1948 this association handled about 831 tons of berries.

Growers in the Fresno area have formed the Fresno Berry Growers' Exchange.

The California Berry Growers' Exchange was formed in 1948, with representatives from different berry cooperatives, and Farm Bureau berry growers throughout the state. It is a statewide

organization and compiles data on total production and market outlets for the entire state.

Know the law. The California Pure Foods Act sets up certain standards and regulations for labeling and declaration of weight, and for quality specifications. These will be found in the California Pure Foods Act, State of California, Department of Public Health, "Summary of Requirements Interpreted by Bureau of Food and Drug Inspection"—December, 1948. It would be advisable for commercial growers to have a copy of these regulations, and to consult the pamphlet when in doubt about regulations.

TABLE 8—Acreage of Bush Berries in Leading California Counties, 1948 *

County	Boysen	Nectar	Young	Logan	Black- berry	Rasp- berry	Blue- berry	Currant	Various	Total
Alameda	18.0	....	2.0	....	....	....	....	100.0	....	120.0
Butte . . . . .	....	....	....	....	....	....	....	....	....	220.0
Fresno	675.0	....	85.0	....	....	....	....	....	82.2	842.2
Kern . . . . .	....	....	....	....	....	....	....	....	....	25.0
Kings . . . . .	....	....	....	....	....	....	....	....	....	30.0
Los Angeles . .	425.0	....	85.0	....	....	50.0	....	....	40.0	600.0
Madera . . . . .	....	....	....	....	....	....	....	....	....	90.0
Marin	1.75		....	....	....	....	3.0	....	....	4.75
Merced . . . . .	....	....	....	....	....	....	....	....	....	113.0
Monterey	321.0	....	....	....	....	....	....	....	36.0	357.0
Orange	162.0	61.0	....	....	3.5	....	....	....	33.5	260.0
Riverside . . . .	....	....	....	....	....	....	....	....	....	100.0
Sacramento . . .	....	....	....	....	....	....	....	....	....	100.0
San Benito . . . .	....	....	....	....	....	....	....	....	....	75.0
San Bernar- dino . . . . .	....	....	....	....	....	....	....	....	....	421.0
San Diego . . . .	....	....	....	....	....	....	....	....	....	16.0
San Joaquin . . .	....	....	....	....	....	....	....	....	....	25.0
San Mateo . . . .	....	....	....	....	....	....	....	....	....	9.0
Santa Clara . . .	....	....	....	....	....	85.0	....	....	54.0	139.0
Santa Cruz	674.05			682.0	40.75	28.25	17.25	....	....	1,442.30
Sonoma	431.6	12.6	127.9	3.5	41.0	10.2	6.3	....	86.9	720.0
Stanislaus	186.0	4.0	10.0	....	....	....	....	....	....	200.0
Tulare . . . . .	....	....	....	....	....	....	....	....	....	499.0
Ventura . . . . .	....	....	....	....	....	....	....	....	....	8.0

* Acreage by varieties not available for some counties, but total berry acreage is listed in last column.
Source of data: Figures based on direct reports from County Agricultural Commissioners and the California Crop and Livestock Reporting Service.

Varietal Chart—Blackberries

Variety	Major planting area	Fruit		Plant characteristics	Harvest period			Yield	Remarks
		Characteristics	Use		So. Cal.	Coast	Cent. valley		
Boysen	General throughout state	Large—high quality—reddish, sweet, aromatic	Fresh Canning Freezing	Moderately vigorous—medium large thorns	May 20 to June 25	May 25 to June 25	June 2 to July 10	Very good	Best yield when grown in Central Valley under intensive cultivation
Nectar	General throughout state	Similar to Boysen but less acid	Fresh Canning Freezing	Cannot be distinguished from Boysen	Same as for Boysen	Same as for Boysen		Very good	Same as Boysen
Young	General throughout state	Lower quality than Boysen—more shiny	Fresh Canning Freezing	Less vigorous than Boysen	May 15 to June 5	May 15 to June 5	May 22 to July 1	25 to 50% less than Boysen	Used in mixed plantings with Boysen to prolong the picking season
Thornless Logan	Coastal area	Sour—similar to Logan in size—light red color	Canning Freezing Juice Baking	Vigorous when given good culture—few if any thorns	..	June 10 to Aug. 1	..	Good when irrigated in central coast	Susceptible to virus diseases which shorten average life of plant
Logan	Coastal area	Sour—similar to Thornless Logan in size—light red	Canning Freezing Juice Baking	Many fine thorns on canes	..	June 15 to Aug. 1	..	Fair in central coast when irrigated	Less popular than thornless, because susceptible to dwarf disease
Thornless Boysen	General throughout state	Lower quality than Boysen	Fresh Canning Freezing	Less vigorous than Boysen	Same as for Young	Same as for Young		Lower than for Boysen	Short-lived—usually 2 to 3 years
Himalaya	Coastal area	Jet black and shiny—medium size—round	Fresh Canning Freezing	Large hooked thorns—canes as much as 1½ inches in diameter—long lived—vigorous	..	July 5 to Sept. 15	..	Good for coastal area	Disliked because of thorns which make picking and pruning difficult
Cory Thornless	General throughout state	Smaller in diameter than Boysen, but sometimes 2 inches long—black—shiny	Fresh Canning Freezing	Vigorous—nearly thornless	May 17 to June 25	May 22 to June 25	May 30 to July 10	Same as for Young	Susceptible to berry mites
Thornless Oregon Evergreen	Experimental plantings only	Small to medium—round—black	Canning or shipping to distant markets—freezing	Moderately vigorous—thornless	..	July 25 to Sept. 1	..	Fair where winters are cold	A late variety—extends picking season
Erect Blackberries									
Lawton	Sebastopol area only, to date	Medium size—black, sweet—excellent quality	Fresh Canning Freezing	Vigorous—large thorns	..	July 5 to Sept. 5	..	Fair 5 tons per acre	Not grown commercially now but desired by canners and freezers
Mountain Blackberry	San Diego Co. only, to date	Fair quality	Fresh	Numerous slender thorns	Apr. 1 to Apr. 25	..	..	Fair to poor	Commercially practical only because of early picking season

Varietal Chart—Raspberries

Variety	Major planting area	Fruit		Plant characteristics	Harvest period		Yield		Remarks
		Characteristics	Uses		Spring	Fall	Spring	Fall	
Cuthbert	Small plantings throughout state	Medium to dark red—good quality—ship well	Fresh or process	Insufficient vigor to produce good crop	May 25	Sept.—Oct.	Good	Fair but failing	Has been popular variety for fresh market and processing. Now difficult to obtain necessary stock free from virus
Lloyd George	Central coast, Sierra foothills	Dark—medium size—fair quality	Fresh	Susceptible to virus diseases	May 25	Sept.	Fair	Poor	Used mostly for home gardens
Ranere	Central coast, Sierra foothills	Bright red—medium size—ship well, fair quality	Fresh	Long life in Sierra foothills	May 21	Through Oct.	Good	Maximum yield 5 ton per acre	Formerly most popular variety for shipping in Santa Clara Valley. Now difficult to find stock free from virus
Washington	Central coast	Small—excellent quality	Fresh	Vigorous, long life—spring crop only	May 21	..	Good	None	Developed for State of Washington—adaptation to California not proved
Willamette	Central coast	Medium red—fair quality—large size	Fresh because of appearance	Good crops following very cold winters	May 25	Sept.	Good	Fair if winter is cold	Developed for Oregon—may do well in northern counties of California
Cumberland (black)	Home gardens throughout state	Large—good quality	Fresh or process	Erect, require no trellis if summer topped to 28"	May 25	..	Poor	None	Unable to compete with red raspberries on yield

Varietal Chart—Currants

Variety	Major planting area	Fruit		Plant characteristics	Harvest period		Yield	Remarks
		Characteristics	Uses		E. of Sierra	Cent. coast		
Fays Prolific	Central coast and east slope of Sierra	Good quality—large, bright red—ripen evenly	Processing	Mod. vigorous—upright to spreading—mod. dense foliage	July 4-31	June 15-July 10	Good	Has produced 6 tons per acre east of Sierra, with irrigation
Cherry	Central coast	Large, bright red—well-filled clusters	Processing	Fairly vigorous—medium size	..	Early June to July 10	Good	Subject to mildew and cane borers. Unirrigated plantings yield 3 tons per acre
Red Lake	Central coast (experimental plantings only)	Medium size—medium red, long, loose, well-filled clusters—good quality	Processing	Moderately vigorous—spreading to upright—dense foliage	..	June 15 to July 15	Excellent	May produce 25 per cent more than Fays Prolific, but berries are smaller
Perfection	(Experimental plantings only)	Largest of any—medium red—good flavor	Processing	Mod. vigorous—upright to spreading—fairly dense foliage	..	June 15 to July 15	Good	Production same as for Fays Prolific
Cascade	(Test plantings only)	Medium to large—fair to good flavor—bright red—tight clusters	Processing	Same as for Perfection	..	June 15 to July 10	Good	Acid content declines rapidly when fruit becomes overripe
Black form of the Golden Currant	Alameda Co.	Large—medium quality—black when ripe	Processing	Resistant to mildew and borers but susceptible to horn-tail	..	Late July	Good	No restrictions on blister rust

Varietal Chart—Blueberries*

Variety	Fruit characteristics	Cluster characteristics	Plant characteristics	Harvest period	Yield	Remarks
Rancocas	Large, light blue, firm—medium scar—good quality—ship well	Tight	Tall, vigorous upright—require severe pruning	June 10 to July 10	5 tons per acre	Propagate easily—fruit does not keep well
Scammel †	Large, dark blue, firm, slight aroma—medium quality—small scar	Long — tight	Erect, vigorous	June 15 to July 15 (probable)	Not known	Berries above medium in dessert quality
Dixi	Large, medium blue, firm, aromatic—good quality	Medium loose	Vigorous, open, spreading	June 20 to July 20 (probable)	Not known	Fruit very large—plant productive
Rubel	Small, light blue, very firm—fairly good quality—ship well	Loose	Tall, vigorous, upright	June 25 to July 25	5 tons per acre	Easy to propagate—fruit medium to small
Atlantic	Large, firm, above medium quality—good scar	Loose	Vigorous, tall, spreading	June 22 to July 25 (probable)	Not known	Productive
Pemberton	Large, dark blue, firm, slight aroma—medium quality—poor scar	Loose—very large	Most vigorous—erect	June 24 to July 25 (probable)	Not known	Easy to propagate—most vigorous of all
Jersey	Large, firm—keep well—no aroma—good scar	Open—long stems	Vigorous, upright—do not sprout from base	June 20 to July 25	5 tons per acre	Stems stick to fruit—must be removed when picking. Plant productive
Burlington	Medium size—good color, firm—above medium quality—good scar	Medium tight	Vigorous, upright, spreading	June 25 to July 25 (probable)	Not known	Propagates easily—quality good—scar one of the best.
Weymouth †	Above medium size—dark blue, firm—poor quality	Medium loose	Erect, open spreading—mod. vigorous	June 3 to July 20 (probable)	Not known	Early—fruit large, but of poor quality
June †	Medium size, dark blue—med. quality	Loose	Not too vigorous—erect	June 5 to July 20 (probable)	Not known	Difficult to propagate—early
Cabot †	Small to medium—good color—low quality	Long—tight	Weak growth—low, spreading	June 7 to July 20 (probable)	Not known	Popular in New York—early

* All varieties observed under commercial conditions were adapted to the Sebastopol and Watsonville areas.
† Experimental plantings only were observed.

REFERENCE MATERIAL ON BUSH BERRIES

United States Department of Agriculture publications may be secured as references in some public libraries, or they may be purchased from the U. S. Superintendent of Documents, Washington, D.C., for the amount noted. Stamps are not accepted.

Note: State experiment station publications are not listed because they may not be available to California residents.

Serial Publications of the United States Department of Agriculture

DARROW, GEORGE M.

1937. Breeding small fruits. U. S. Dept. Agr. Yearbook Separate 1583 Y:445-574. (15 cents.)

DARROW, GEORGE M., and S. B. DETWILER.

1938. Currants and gooseberries: their culture and relation to white pine blister rust. U. S. Dept. Agr. Farmers' Bul. 1398 F:1-42. 27 figs. Revised ed. (10 cents.)

DARROW, GEORGE M., and GEORGE F. WALDO.

1932. The Brainerd blackberry. U. S. Dept. Agr. Cir. 220 C:1-4, 2 figs. (5 cents.)

1948. Raspberry culture. U. S. Dept. Agr. Farmers' Bul. 887 F:38. 25 figs. Revised ed. (5 cents.)

DARROW, GEORGE M. R. B. WILCOX, and CHARLES S. BECKWITH.

1946. Blueberry growing. U. S. Dept. Agr. Farmers' Bul. 1951 F:1-33. 23 figs. Revised ed. (10 cents.)

DODGE, B. O., and R. B. WILCOX.

1932. Diseases of raspberries and blackberries. U. S. Dept. Agr. Farmers' Bul. 1483 F:1-32. 20 figs. Revised ed. (5 cents.)

Books

AUCHER, E. C., and H. B. KNAPP.

1929. Growing tree and small fruits. 510 p. John Wiley and Sons, New York, N.Y.

SHOEMAKER, J. S.

1948. Small fruit culture. 433 p. The Blakiston Co., Philadelphia, Pa.

VAN METER, R. A.

1928. Bush fruit production. 128 p. Orange Judd Co., New York, N.Y.

The following publications were used as source material for some of the statements made in this circular.

BENNETT, C. W.

1927. Virus diseases of raspberries. Michigan Agr. Exp. Sta. Tech. Bul. 80:1-80.

KUHLMAN, GUSTAV W., and D. CURTIS MUMFORD.

1948. Cost of producing boysenberries for processing in the Willamette Valley, Oregon. Ore. Agr. Exp. Sta. Cir. of Information 447.

RANKIN, W. HOWARD.

1927. Mosaic of raspberries. New York (Geneva) Agr. Exp. Sta. Bul. 543:1-60.

The author wishes to express his appreciation for the assistance given by Dr. Stephen Wilhelm, of the Division of Plant Pathology, Berkeley, in the preparation of the material on berry diseases, and to Dr. Leslie M. Smith, of the Division of Entomology, Davis, for assistance in the preparation of the material on insect pests.

In order that the information in our publications may be more intelligible it is sometimes necessary to use trade names of products or equipment rather than complicated descriptive or chemical identifications. In so doing it is unavoidable in some cases that similar products which are on the market under other trade names may not be cited. No endorsement of named products is intended nor is criticism implied of similar products which are not mentioned.

Coöperative Extension work in Agriculture and Home Economics, College of Agriculture,
University of California, and United States Department of Agriculture coöperating.
Distributed in furtherance of the Acts of Congress of May 8, and June 30, 1914.
J. Earl Coke, Director, California Agricultural Extension Service.

THIS DOOR SWINGS OPEN TO ANSWER QUESTIONS



Bring your farming questions to your County Farm Advisor—he's an agricultural specialist with a background of practical experience. And he's there to help you. If he can't answer your question himself, he'll find someone who will.

Farm Advisors serve 52 counties in California, with offices in the towns listed below. Get to know yours—make use of his free service.

Alameda County:
Post Office Bldg., Hayward

Butte County:
Federal Bldg., Oroville

Colusa County:
Federal Bldg., Colusa

Contra Costa County:
Cowell

Del Norte County:
Post Office Bldg., Eureka

El Dorado County:
Post Office Bldg., Placerville

Fresno County:
Post Office Bldg., Fresno

Glenn County:
607 5th St., Orland

Humboldt County:
Post Office Bldg., Eureka

Imperial County:
Court House, El Centro

Kern County:
2610 M St., Bakersfield

Kings County:
131 E. 8th St., Hanford

Lake County:
Kelseyville

Lassen County:
Memorial Bldg., Susanville

Los Angeles County:
511 E. Aliso St.,
Los Angeles 12

Madera County:
Post Office Bldg., Madera

Marin County:
Post Office Bldg., San Rafael

Mariposa County:
Fairgrounds, Mariposa

Mendocino County:
Court House, Ukiah

Merced County:
County Adobe Bldg.,
Court House Square, Merced

Modoc County:
1621 Main St., Alturas

Monterey County:
Court House, Salinas

Napa County:
Post Office Bldg., Napa

Nevada County:
Memorial Bldg.,
Grass Valley

Orange County:
1104 W. 8th St., Santa Ana

Placer County:
1389 Lincoln Way, Auburn

Plumas County:
Court House, Quincy

Riverside County:
Post Office Bldg., Riverside

Sacramento County:
315 Federal Bldg.,
Sacramento 2

San Benito County:
Court House, Hollister

San Bernardino County:
566 Lugo Ave.,
San Bernardino

San Diego County:
4005 Rosecrans St.,
San Diego 10

San Joaquin County:
145 S. American St.,
Stockton 2

San Luis Obispo County:
997 Monterey St.,
San Luis Obispo

San Mateo County:
Half Moon Bay

Santa Barbara County:
Federal Bldg.,
Santa Barbara

Santa Clara County:
201 Post Office Bldg.,
San Jose 13

Santa Cruz County:
555 Ocean St.,
Santa Cruz

Shasta County:
County Office Bldg., Redding

Sierra County:
Court House, Quincy

Siskiyou County:
Court House, Yreka

Solano County:
County Library Bldg.,
Fairfield

Sonoma County:
Court House, Santa Rosa

Stanislaus County:
Federal Bldg., Modesto

Sutter County:
Post Office Bldg., Yuba City

Tehama County:
Federal Bldg., Red Bluff

Trinity County:
Court House, Weaverville

Tulare County:
Post Office Bldg., Visalia

Tuolumne County:
815 Washington St., Sonora

Ventura County:
52 N. California St., Ventura

Yolo County:
Court House, Woodland

Yuba County:
Federal Bldg., Marysville



**CALIFORNIA AGRICULTURAL EXTENSION
SERVICE • COLLEGE OF AGRICULTURE
UNIVERSITY OF CALIFORNIA**